

PONTOBDELLINAE (PISCICOLIDAE : HIRUDINEA)

IN THE BRITISH MUSEUM (NATURAL HISTORY)  
WITH A REVIEW OF THE SUBFAMILY

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*Pp. 389-439 ; 28 Text-figures*

BULLETIN OF  
THE BRITISH MUSEUM (NATURAL HISTORY)  
ZOOLOGY

Vol. 14 No. 7

LONDON : 1966

THE BULLETIN OF THE BRITISH MUSEUM (NATURAL HISTORY), instituted in 1949, is issued in five series corresponding to the Departments of the Museum, and an Historical series.

Parts will appear at irregular intervals as they become ready. Volumes will contain about three or four hundred pages, and will not necessarily be completed within one calendar year.

In 1965 a separate supplementary series of longer papers was instituted, numbered serially for each Department.

This paper is Vol. 14, No. 7 of the Zoological series. The abbreviated titles of periodicals cited follow those of the World List of Scientific Periodicals.

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THE BRITISH MUSEUM (NATURAL HISTORY)

Issued 9 September 1966

Price £1

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\* Species not examined during this study, but well described *in litteris*, appear above in brackets.

## SYNOPSIS

The conspicuously tuberculate marine leeches may conveniently be separated in a new subfamily Pontobdellinae containing the genera *Stibarobdella*, *Pontobdella*, and *Pentabdella* gen. nov., for species in which the mid-body somites bear three†, four and five annuli respectively.

The internal anatomy of *Stibarobdella macrothela* is described and is found to be similar to that of *Pontobdella muricata*, except that the former has a somewhat longer proboscis, a pair of lateral diverticula near the origin of the caecum, traces of caecal fenestrae, more elongated

† or no more than three (p. 439).

seminal vesicles and ovaries and the abdominal ganglia less widely separated from one another. The extra annulus in each abdominal somite of *Pontobdella* seems to be innervated from the ganglion anterior to it.

Of the *Stibarobdella* examined, *S. macrothela* is particularly characterized by a very large posterior sucker, amorphous tubercles with large, more or less square basal areas and a pair of ocular patches; *S. loricata* by a large anterior sucker with a fringe; *S. bimaculata* by small suckers and tubercles and a pair of ocular patches; and *S. variegata* by a mid-ventral tubercle on each  $a_2$  annulus.

Of the *Pontobdella* examined, *P. muricata* is distinguished by a large anterior sucker with a fringe and *P. vosmaeri* by a small anterior sucker lacking a fringe and by a mid-ventral tubercle on each  $a_2$  annulus.

Complete descriptions of external characters are given for these species, all the literature relating to the Pontobdellinae is reviewed and attention is drawn to a number of *species inquirendae*. A key is constructed for the identification of the species reviewed.

## INTRODUCTION

THE group of closely related Piscicolid marine leeches, which are characterized by possessing numerous tubercles on each body somite, are often placed in the single genus *Pontobdella* Leach. Many of the descriptions of these leeches are inadequate or based on characters which vary individually in those species which have been more thoroughly studied. The literature about them is scattered and needs reviewing. In the absence of convenient works of identification, the British species are not well known. Examination of material in the collection of the Plymouth Laboratory, for instance, revealed the presence of two species, preserved together under the same name, *Pontobdella muricata* (L.), the second, previously unrecognized species being *Pontobdella vosmaeri* Apathy.

A preliminary examination of fifty specimens of *Pontobdella muricata*, the most examined from one species, showed that the characters of the suckers were a reliable guide to identification. Papillation and relative size always appeared to be reasonably constant, though slight variations in size due to contraction obviously had to be taken into account. The number of annuli in the clitellar constriction, however, may be cited as an example of a character which occasionally varies slightly. The number and distribution of the smaller tubercles is also variable, particularly on the smaller annuli. Some of the specimens examined appeared to be rather starved and contracted, having a slender anterior region separated by the clitellum from a broad, flattened posterior region. These unsatisfactory characters were used by Harding (1927) as diagnostic of the subgenus *Pontobdellina*, which he erected for the single species *Pontobdella macrothela* Schmarda.

Harant (1929), too, proposed a questionable new genus *Parapontobdella*, for *Pontobdella tatejamensis*, which was described rather briefly by Oka (1910). He separated it on the grounds that it was said to possess some indication of lateral vesicles. According to Selensky (1915), however, it is quite usual for a species of *Pontobdella* to show a few somewhat inconspicuous vesicles, so although there are insufficient reasons for retaining *tatejamensis* in *Pontobdella* (see p. 436), *Parapontobdella* may have to be separated on other characters.



As my studies progressed it became evident that one set of characters, which was always constant in any species, was the number of annuli per somite. This seems important because, in the past, closely related Piscicolidae, such as *Piscicola* and *Calliobdella*, have been divided on the basis of the number of annuli per somite, together with secondary differences. It is convenient, therefore, to use a similar criterion of classification for those species usually assigned to *Pontobdella*. All the species in this group are either, tri-, tetra- or pentameric, i.e. each somite of the testicular and caecal (blind-gut) regions is composed of three, four or five annuli respectively. The additional annuli per somite necessitate modification of the nervous system to innervate them. I propose, therefore, to follow Harant (1929) in restricting *Pontobdella*, to include only tetrameric species, and redefining *Stibarobdella*, to include all trimeric species, and to name a third genus for the only known pentameric species. The three genera can then be placed conveniently in a new subfamily, the Pontobdellinae, when the new classification becomes as follows:—

Subfamily **Pontobdellinae**

Genus *Stibarobdella* Leigh-Sharpe, 1925, for trimeric species (but see p. 439)

Genus *Pontobdella* Leach, 1815, for tetrameric species

Genus *Pentabdella* gen. nov., for pentameric species

The sections which follow aim to give : 1. An introduction to the internal anatomy of these forms by comparing dissections of the type species of the genera *Stibarobdella* and *Pontobdella*. 2. A systematic account of the genera and species placed in the sub-family, accompanied by details of several *species inquirendae*.

MATERIAL

About seventy-five specimens in the British Museum (Natural History) were examined and about twenty-five from Plymouth. They comprised seven species, two of which occur at Plymouth. The number examined of a particular species is given later, at the beginning of the description of the species.

ANATOMICAL COMPARISON OF  
*STIBAROBDELLA MACROTHELA* AND *PONTOBDELLA MURICATA*

The internal anatomy of *Pontobdella muricata* is fairly well known from the work of Bourne (1884), Vaillant (1870) and Leydig (1851), but that of *Stibarobdella macrothela* is hardly known at all. The general dissections depicted in Text-figs. 1 and 2 show the relationship of the organs to the somites of the body. The following description applies to both species unless stated otherwise.

**GUT.** The proboscis in *Pontobdella muricata* extends from somite VII to the middle of somite IX, while in *Stibarobdella macrothela* it extends from somite VII into the anterior part of somite X, at least a specific taxonomic difference according to Selensky (1915). Clearly visible protractor muscles are attached to the posterior end of the proboscis sheath. Along each side of the oesophagus and pharynx lie salivary glands which penetrate the proboscis at its base. The oesophagus is short and its precise limits are difficult to determine. The anterior portion of the intestine,

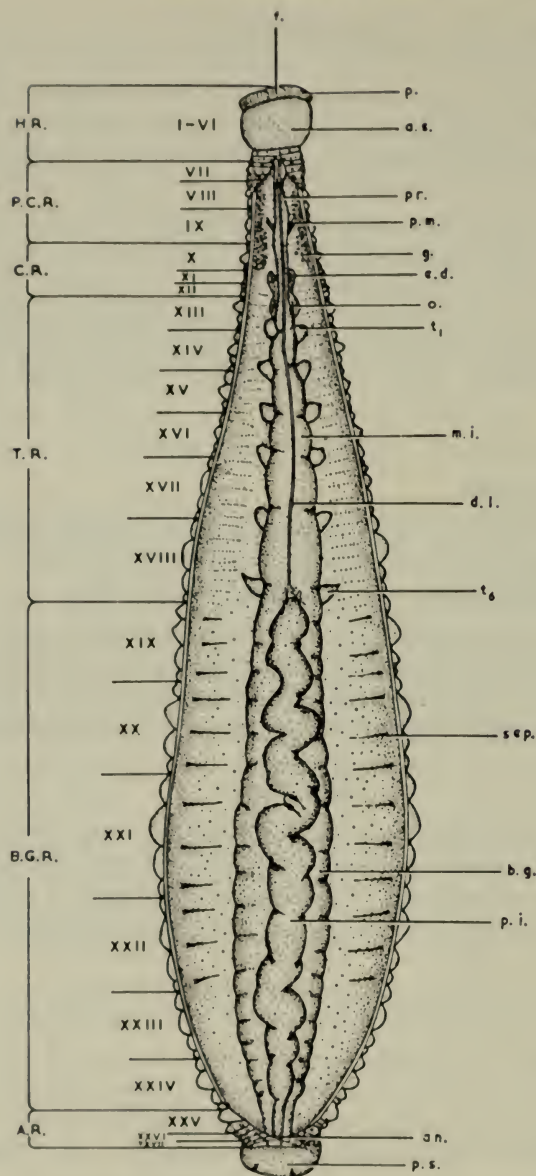


FIG. 1. General dissection of *Pontobdella muricua* to show relationship of organs to somites of the body. I-XXVII, numbering of somites; *an.*, anus; *A.R.*, anal region; *a.s.*, anterior sucker; *b.g.*, caecum (blind-gut); *B.G.R.*, caecal region (blind-gut region); *C.R.*, clitellar region; *d.l.*, dorsal blood vessel; *e.d.*, ejaculatory duct; *f.*, fringe; *g.*, salivary gland cells; *H.R.*, head region; *m.i.*, mid-intestine; *o.*, ovary; *p.*, papilla; *P.C.R.*, pre-clitellar region; *p.i.*, posterior intestine; *p.m.*, protractor muscle; *pr.*, proboscis; *p.s.*, posterior sucker; *sep.*, septa; *t<sub>1</sub>-t<sub>6</sub>*, testes; *T.R.*, testicular region.

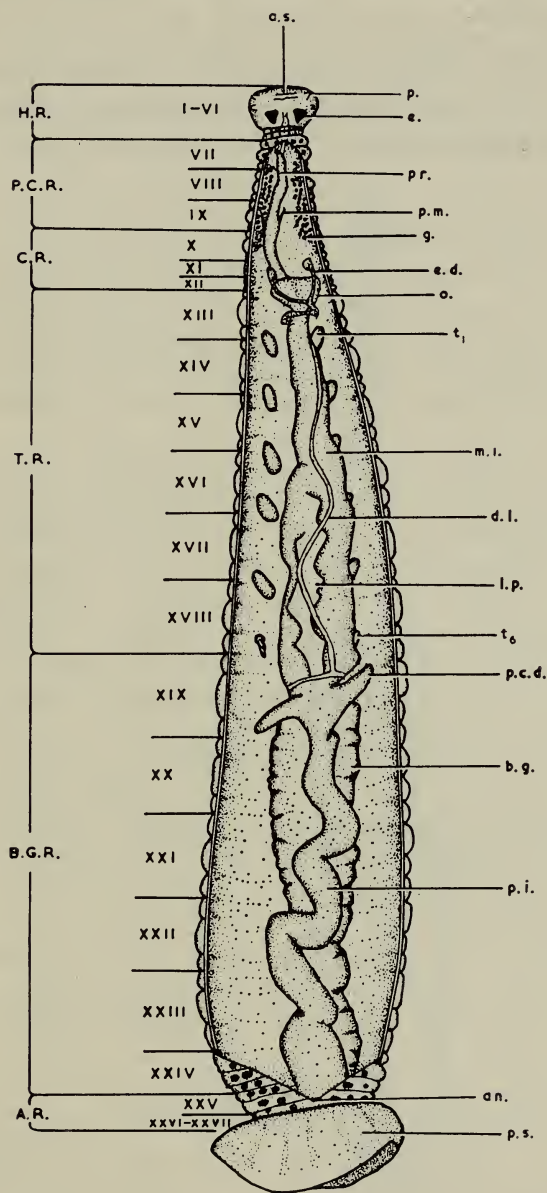


FIG. 2. General dissection of *Stibarobdella macrothela* to show relationship of organs to somites of the body. *e.*, pigmented eye patches; *l.p.*, lateral projections of mid-intestine; *p.c.d.*, diverticula. See Fig. 1 (p. 394) for other abbreviations.

which stretches from the posterior edge of the oesophagus to the XIIth or last clitellar somite, is fairly thick-walled in *Stibarobdella*, while it appeared to be more membranous in *Pontobdella*. A very small pair of diverticula come out from the gut in somite XI, though Selensky (1915) found these in somite X. It should be noted that Selensky in fact called this somite VIII, but believed the head complex to contain four somites; it is now regarded as containing six somites (Mann, 1953), so appropriate amendments are made here and throughout the text following.

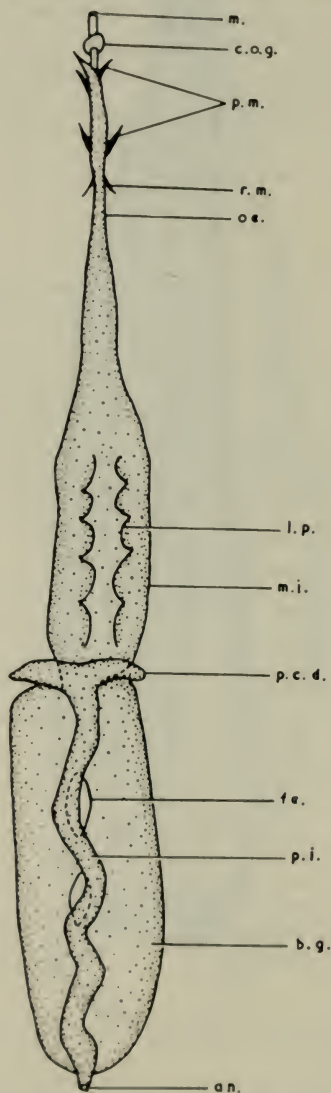


FIG. 3. Gut of *Stibarobdella macrothela*: c.o.g., circum-oesophageal ganglion; fe., fenestra; m., mouth; oe., oesophagus; r.m., retractor muscle. See Figs. 1 & 2 (p. 394 & p. 395) for other abbreviations.



The mid-intestine, which extends throughout the testicular region, is divided by constrictions into six chambers in *Pontobdella muricata*, corresponding to the six somites (XIII to XVIII) of this region. In *Stibarobdella macrothela* there are instead small lateral projections on the dorsal surface of the mid-intestine (Text-fig. 3). From the posterior end of the mid-intestine arises the caecum, which in *Pontobdella* is entirely unpaired and extends ventrally from somites XVIII to XXVI. In *Stibarobdella* it extends from somites XIX to XXVI and shows signs of fenestrae in somites XX and XXII, although these were not particularly clear and seem unimportant in distinguishing genera. Selensky (1915) regarded the degree of fusion of caeca as generally constant within a genus, but Moore (1938) found in *Pontobdella rugosa* that the last pair of caeca are only partially fused with five fenestrae. The caecum in *Pontobdella muricata* shows slight constrictions corresponding to the increased musculature or rudimentary septa found between annuli  $a_1-a_2$ ,  $a_2-b_5$  and within the small annulus  $b_6$ , but these cannot easily be distinguished in *Stibarobdella macrothela*. The labelling of annuli is explained by Mann (1953) and can be seen in Text-fig. 9 (p. 403).

The posterior intestine extends from somites XIX to XXVII and is surrounded for most of its length by a blood sinus, which anterior to this forms the dorsal blood vessel. In *Stibarobdella macrothela* there is a large pair of diverticula in somite XIX, but in *Pontobdella muricata* there is only a slight swelling here. Beyond this the intestine winds backwards. Numerous septa occur within it, but these are not obvious from the exterior. Finally, the rectum is short and rather inconspicuous and terminates at the anus between somites XXVI and XXVII, or in *Pontobdella muricata* between the annuli of somite XXVI, or in the anterior annulus of this somite.

**REPRODUCTIVE SYSTEM.** Both species possess six pairs of oval testes (Text-figs. 4 and 5), situated posteriorly in somites XIII to XVIII. When fully ripe each overlaps into the somite behind, becoming virtually intersegmental. Richardson (1950) described *Pontobdella benhami* (= *Stibarobdella macrothela*) as having three pairs of testes and according to his diagram the vas deferens looped posteriorly for another two somites after the posterior testes. It seems, however, that it is quite possible for this leech to possess six pairs of testes, as is normal in Piscicolidae. In *Pontobdella muricata* each of the vasa efferentia leaves the testis antero-laterally, while in *Stibarobdella macrothela* it leaves postero-ventrally. This character, however, may perhaps vary with contraction and during the ontogeny. The vasa efferentia proceed laterally to join the vas deferens on each side. This proceeds anteriorly, following a more wavy course in *Pontobdella muricata*, and joins the ejaculatory duct in somite XI in this form, but in somite XII in *Stibarobdella macrothela*. The ejaculatory duct communicates posteriorly with a long coiled vesicula seminalis and extends anteriorly as far as somite XI, where it coils postero-ventrally and finally enters the dorsal portion of the genital atrium, which is divided dorso-laterally into two pouches. The male pore opens in somite XI, between the second and third annulus in *Pontobdella muricata*, and between the two annuli of this somite in *Stibarobdella macrothela*.

The paired ovaries are tubular but comparatively short, leading into short oviducts

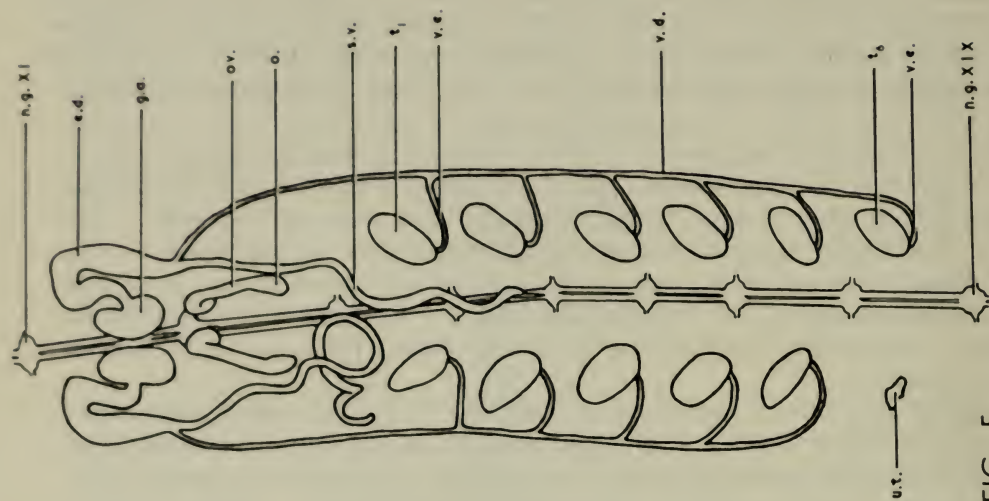


FIG. 4

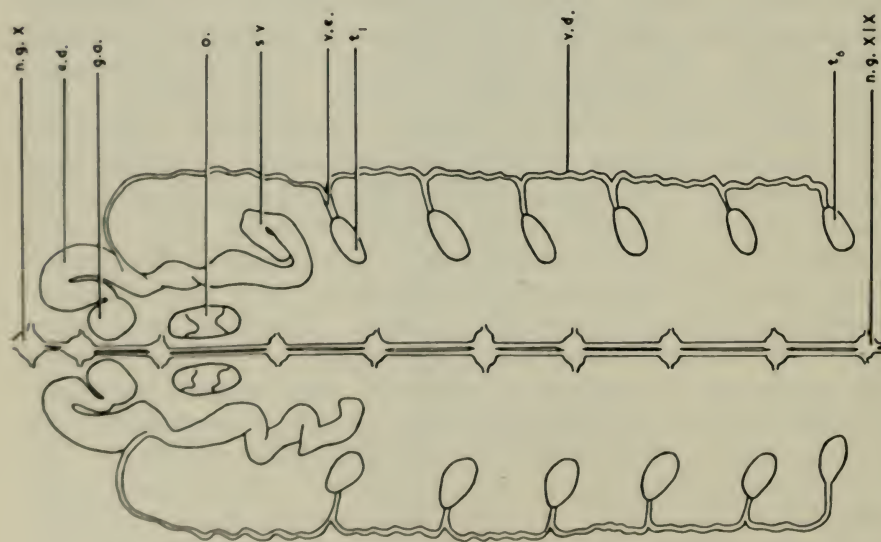


FIG. 5

FIGS. 4, 5. Fig. 4. Reproductive system of *Pontobdella muricata*. e.d., ejaculatory duct; g.a., genital atrium; n.g. X-XIX, nerve ganglia of somites X-XIX; o., ovary; s.v., vesicula seminalis; t<sub>1</sub>-t<sub>6</sub>, testes; v.d., vas deferens; v.e., vas efferens. Fig. 5. Reproductive system of *Stibarobdella macrothela*. ov., oviduct; u.t., undeveloped testis. See Fig. 4, p. 398, for other abbreviations.

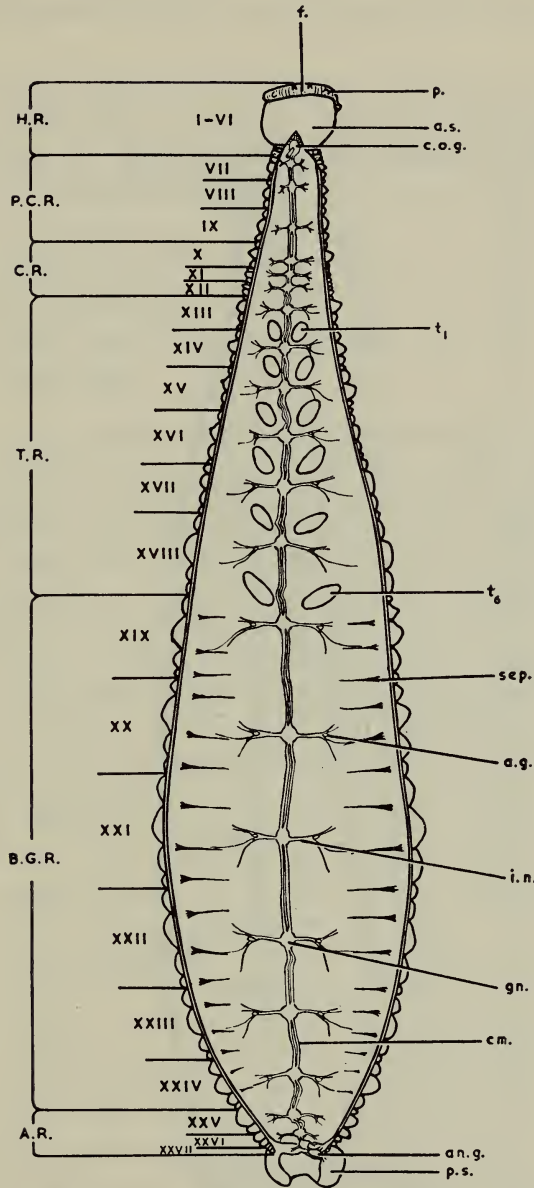


FIG. 6. Dissection to show the arrangement of ganglia in the neurosomites of *Pontobdella muricata*. *a.g.*, accessory ganglion (or lateral glia cells); *an.g.*, anal ganglion; A.R., anal region; *a.s.*, anterior sucker; B.G.R., caecal region (blind-gut); *cm.*, commissure; *c.o.g.*, circum-oesophageal ganglion; C.R., clitellar region; *f.*, fringe; *gn.*, ganglion; H.R., head region; *i.n.*, segmental nerve; *p.*, papilla; P.C.R., preclitellar region; *p.s.*, posterior sucker; *sep.*, septa; *t<sub>1</sub>-t<sub>6</sub>*, testes; T.R., testicular region.

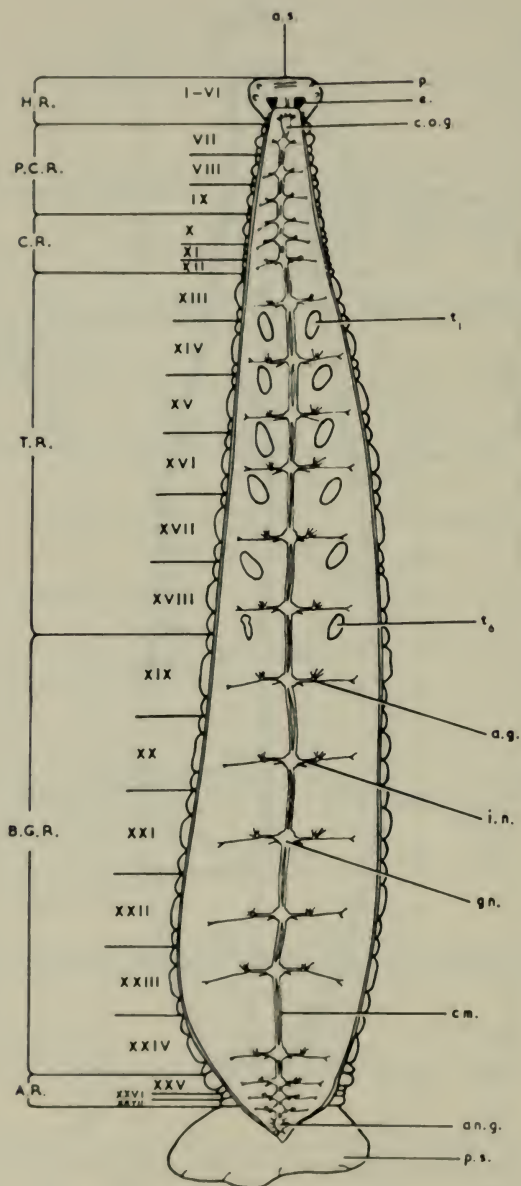


FIG. 7. Dissection to show the arrangement of ganglia in the neurosomites of *Stibarobdella macrothela e.*, pigmented eye patches. See Fig. 6 (p. 399) for other abbreviations.



which terminate in the female pore, between the two annuli of somite XII in *Stibarobdella macrothela*, and between the first and second annulus of somite XII in *Pontobdella muricata*.

**NERVOUS SYSTEM AND ANNULATION.** Between the circum-oesophageal and anal ganglionic masses, lie twenty-one ganglia joined by commissures, which mark a corresponding number of somites (Text-figs. 6 and 7). These are grouped by Johansson (1896) and others as follows:—

Preclitellar region	3
Clitellar region	3
Testicular region	6
Caecal (blind-gut) region	6
Anal region	3

Following Mann (1953), we may provisionally assume that the circum-oesophageal mass consists of six neurosomites, in spite of older views that it consists of four (Livanow, 1903 and 1904, and others). In *Pontobdella muricata* it innervates the anterior sucker plus the adjoining three narrow annuli, which together constitute the head region. The widths of these three annuli are in the ratio 1:1:2. In *Stibarobdella macrothela* the arrangement of the head region is very similar, except that occasionally only two neck annuli can be distinguished.

In both species, the next three neuro-somites of the preclitellar region VII-IX are trimeric, with their annular widths varying in the ratio 1:2:1. The anterior limit of the clitellar region is rather ambiguous in all Pontobdellinae. The most obvious external clue to the position of the clitellum is a constriction of the body and a reduction in width of the annuli there. The size and number of tubercles are also reduced. The most anterior of these narrow annuli is the last annulus of somite X and the most posterior is the first annulus of somite XIII. The term "clitellar region" generally given to the three somites X-XII does not therefore coincide exactly with the narrow and modified part of the body.

Posterior to the clitellar region lies the testicular region which is made up of six somites, XIII to XVIII. In *Stibarobdella macrothela* these are trimeric, with their widths varying in the ratio 1:2:1, while in *Pontobdella muricata* they are tetrameric with their widths varying in the ratio 2:3:2:1. The ganglia always appear to be situated within the limits of the largest annulus. Behind this region lies the caecal region, which is also made up of six somites XIX to XXIV, having an arrangement similar to that in the previous region.

The anal region is made up of three somites, XXV to XXVII, containing three ganglia which are much closer together. In *Stibarobdella macrothela* somite XXV consists of two annuli and XXVI and XXVII of one annulus each. Finally, the posterior ganglionic mass of the posterior sucker is regarded as consisting of seven fused ganglia, making a total of thirty-four in all.

The distance between ganglia varies considerably and is least towards the extremities of the nerve chain and in the clitellar region (Text-fig. 8). In *Pontobdella*

*muricata* the distance between ganglia in the caecal region is relatively greater than in *Stibarobdella macrothela*.

Each ganglion consists of ganglia cells arranged into six cell packets or capsules, with one pair on each side and one pair mid-ventrally, making three longitudinal rows. Through the middle of the ganglion run two fibrous tracts, which fuse at the centre of the ganglion (Harant & Grassé, 1959) and continue as the commissures linking successive ganglia, each tract possessing a single "commissural cell" making a total of two between adjacent ganglia. From the fibrous tract at the centre of the ganglion the main segmental nerve runs out on each side. In *Pontobdella muri-*

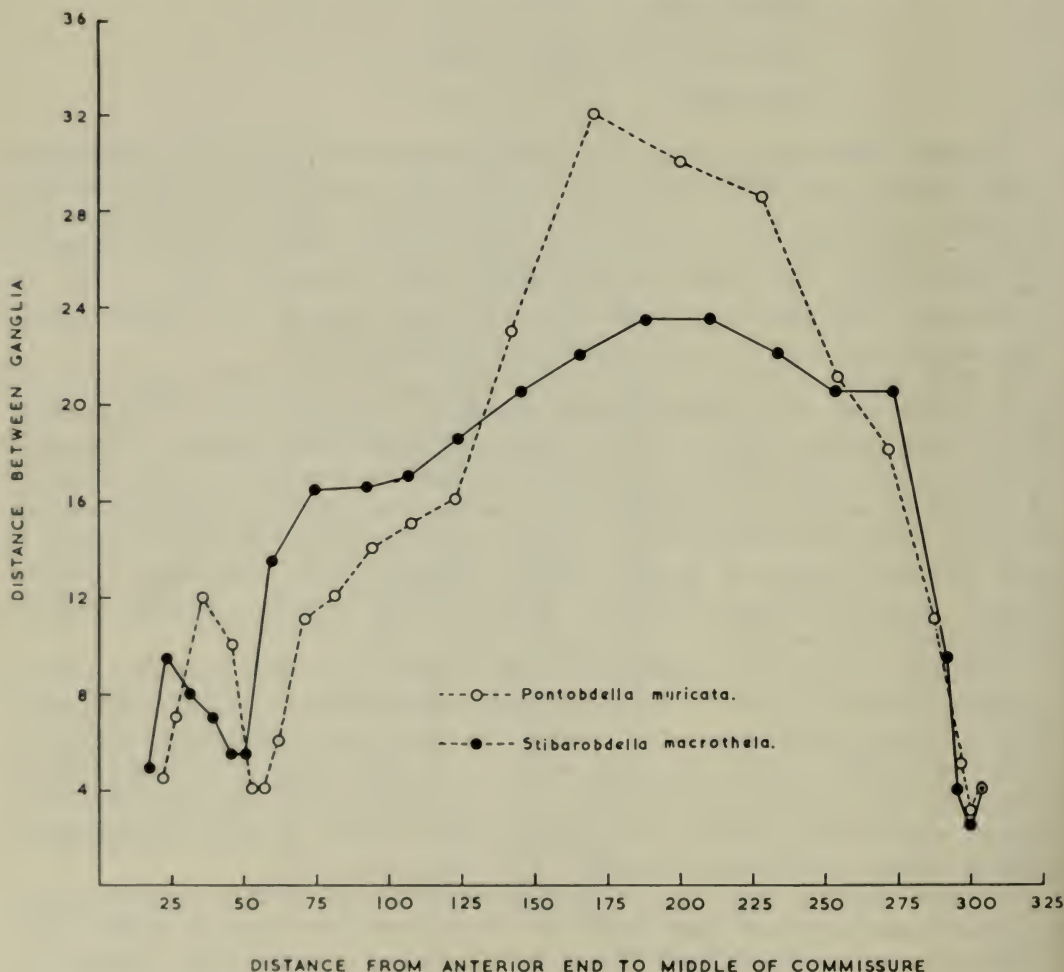


FIG. 8. Graph to show relative distances between ganglia in *Pontobdella muricata* and *Stibarobdella macrothela* and the elongation of the caecal (blind-gut) region in the former. The scales for the axis and abscissa are in arbitrary units which differ slightly between species. The measurements were taken from one specimen of each species.

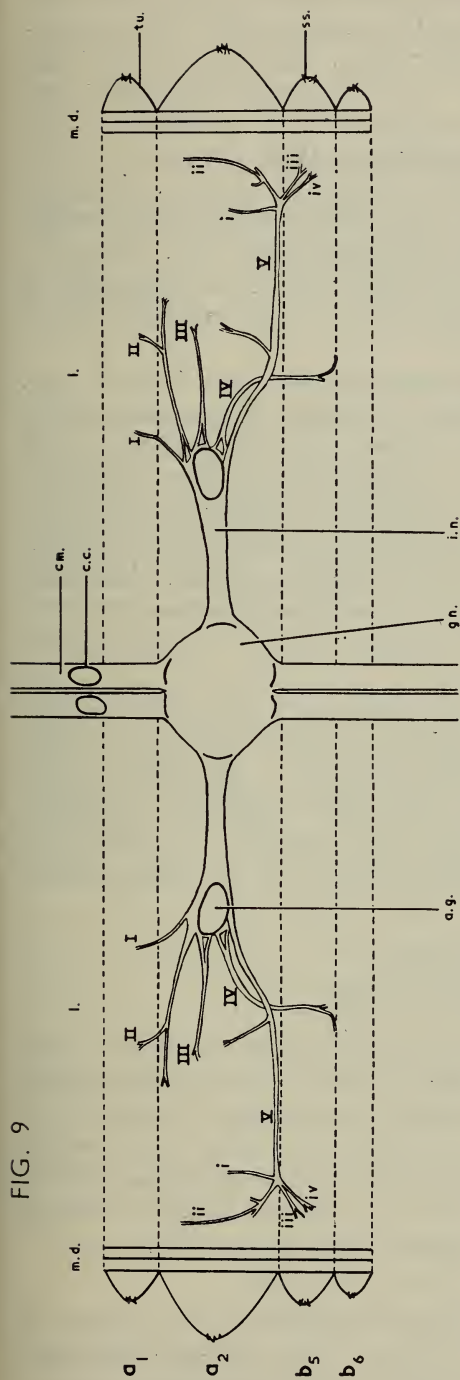


FIG. 9

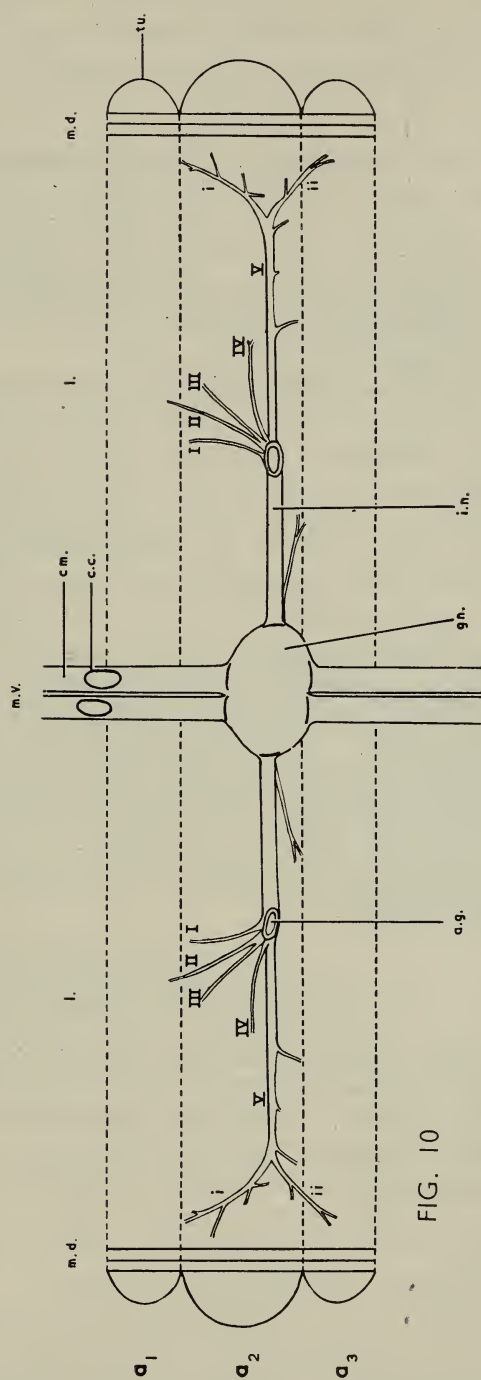


FIG. 10

Figs. 9, 10. Fig. 9. Neurosomite of *Pontobdella muricata* showing the main nerve branches. For designations of annuli (i.e.  $a_1$ ,  $a_2$ ,  $b_5$  and  $b_6$ ) see Mann, 1953.  $a.g.$ , accessory ganglion (or lateral glia cells);  $c.c.$ , commissural cell;  $cm.$ , commissure;  $gn.$ , ganglion;  $i.n.$ , segmental nerve;  $l.$ , lateral line;  $m.d.$ , mid-dorsal line;  $m.v.$ , mid-ventral line;  $ss.$ , sensilla;  $tu.$ , tubercle. I-V, numbering of somitic nerves. i-iv, numbering of branches of nerve V. Fig. 10. Neurosomite of *Stibarobdella macrothela* showing the main nerve branches. For designations of annuli (i.e.  $a_1$ ,  $a_2$  and  $a_3$ ) see Mann, 1953. i-ii, numbering of branches of nerve V. See Fig. 9 for other abbreviations.



*cata*, in the testicular and caecal region, this nerve divides near the lateral glia cells or accessory ganglia (Scriban & Autrum, 1934) into five main branches (Text-fig. 9). Nerve I, the most anterior branch, is comparatively small. It turns ventrally and innervates the ventral portion of annulus  $a_1$ . Nerve II curves anteriorly and innervates annulus  $a_1$  laterally. Nerve III runs laterally and terminates in the lateral region of annulus  $a_2$ . Nerve IV runs laterally for a short distance and then posteriorly until it reaches the boundary between annulus  $b_5$  and  $b_6$ . There it divides, the main branch turning laterally again and running along this boundary. It seems likely that one of these nerve branches innervates annulus  $b_6$ . Nerve V, which is the largest of these nerves, runs along the boundary between annuli  $a_2$  and  $b_5$  until it subdivides dorso-laterally into four branches (i-iv), innervating the lateral and dorsal regions of annulus  $a_2$  and  $b_5$ .

*Stibarobdella macrothela* differs from this condition in several ways (Text-fig. 10). The main segmental nerve trunk gives off a branch as it leaves the ganglion, which terminates ventrally in the region of the border between annulus  $a_2$  and  $a_3$ . As in *Pontobdella muricata* there are five main branches at the lateral glia cells, of which I, II and III run anteriorly. Nerve IV appeared to terminate laterally in annulus  $a_2$ . The main branch, nerve V, had a small branch in the region of the lateral line, which ran posteriorly and terminated at the border between annulus  $a_2$  and  $a_3$ . The main branch continued dorsally with two very small branches running posteriorly, until in the dorso-lateral region of annulus  $a_2$  it divided, the posterior branch ii terminating in annulus  $a_3$ , the anterior branch i in annulus  $a_2$ .

It can be seen that the arrangement of nerves I, II, III and V is somewhat similar in the two species. Only nerve IV is strikingly different, being elongated posteriorly in *Pontobdella muricata* and apparently innervating annulus  $b_6$ . This supports the view put forward by Oka (1917), who stated that the fourth annulus of a tetrameric somite is derived from the  $a_3$  annulus. It seems that annulus  $b_6$  is indeed the posterior annulus of the somite and that the modifications are for the innervation of this fourth annulus.

### Family PISCICOLIDAE

#### Subfamily PONTOBDELLINAE, Subfam. nov.

**DIAGNOSIS.** Characterized particularly by the tubercles, which occur on at least the major ( $a_2$ ) annulus of each somite and usually on most annuli of the testicular and caecal regions. The latter regions are divided into trimeric, tetrameric or pentameric somites. The body is circular or slightly flattened in cross section. The clitellar constriction does not coincide exactly with the three clitellar somites (X, XI, and XII) of the "clitellar region" defined by Johansson (1896) for most Hirudineae, but extends from  $Xa_3$  to  $XIIIa_1$  inclusive (Text-figs. 11-28).

**TYPE GENUS.** *Pontobdella* Leach, 1815.

**REMARKS.** Pending further studies the remaining Piscicolidae should perhaps be grouped as the Piscicolinae and Branchelliinae (Caballero, 1956) and may eventually be divided further. Leigh-Sharp (1916) suggested that those possessing pulsatile



vesicles or other respiratory appendages might be separated off as the Branchiobdellinae, but this name is unacceptable, since *Branchiobdella* is an oligochaete, and there are intermediate forms, such as *Johanssonia* and *Austrobdella*, which make such separation difficult.

Genus **STIBAROBDELLA** Leigh-Sharpe, 1925\*

*Stibarobdella* Leigh-Sharpe, 1925 : 417 ; Harant, 1929 : 651.

*Pontobdella* (*Pontobdellina*) Harding, 1927 : 44.

TYPE SPECIES. *Pontobdella macrothela* Schmarda.

DIAGNOSIS. Somites of the testicular and caecal regions trimeric (but see p. 439)

***Stibarobdella macrothela*** (Schmarda, 1861).

*Pontobdella macrothela* Schmarda, 1861 : 6.

*Pontobdella afra* Baird, 1869 : 312.

*Pontobdella papillata* Grube, 1871 : 56.

*Pontobdella zonata* Weber, 1915 : 20.

*Pontobdella* (*Pontobdellina*) *macrothela* : Harding, 1927 : 45.

*Pontobdella benhami* Richardson, 1950 : 97.

*Trachelobdella carajibica* Dequal, 1917 : 2.

*Stibarobdella superba* Leigh-Sharpe, 1925 : 417.

DESCRIPTION. *General characters.* About thirty specimens were examined. The testicular and caecal regions are somewhat flattened, except when fully gorged, and are distinctly broader than and clearly separated from those regions anterior to them. The body varies from yellowish brown to bluish green, even in preserved material, with the tubercles generally white or cream, and sometimes with bands or patches of pigment. The length may reach 16.5 cm., excluding suckers. The anterior sucker is slightly oval, elongated transversely and attached eccentrically, with the dorsal surface longer than the ventral. It lacks a marginal fringe (Text-fig. 11A and 12), but possesses three pairs of tentacular papillae situated marginally and one pair laterally nearer the base of the sucker. These are occasionally rather difficult to see. All specimens examined had coronet-shaped (ocular?) pigment patches on the dorsal surface of the anterior sucker, although in one long preserved specimen these had become extremely faint. The posterior sucker, which is attached centrally, is between two and three times the size of the anterior sucker and is generally almost twice the diameter of its attachment and broader than the broadest part of the body. When contracted, however, it may be little more than half the greatest breadth of a fully gorged specimen. Sometimes it bears dark and light radiating bands or patches.

ANNULATION.	Uniannulate somites			
	Biannulate somites	XI, XII	} XXV, XXVI	} XXVII
	Triannulate somites	VII-X, XIII-XXIV		(Text-fig. 12)

The first three annuli of the body, the anterior two of which are particularly narrow, constitute the neck, which together with the anterior sucker makes up the

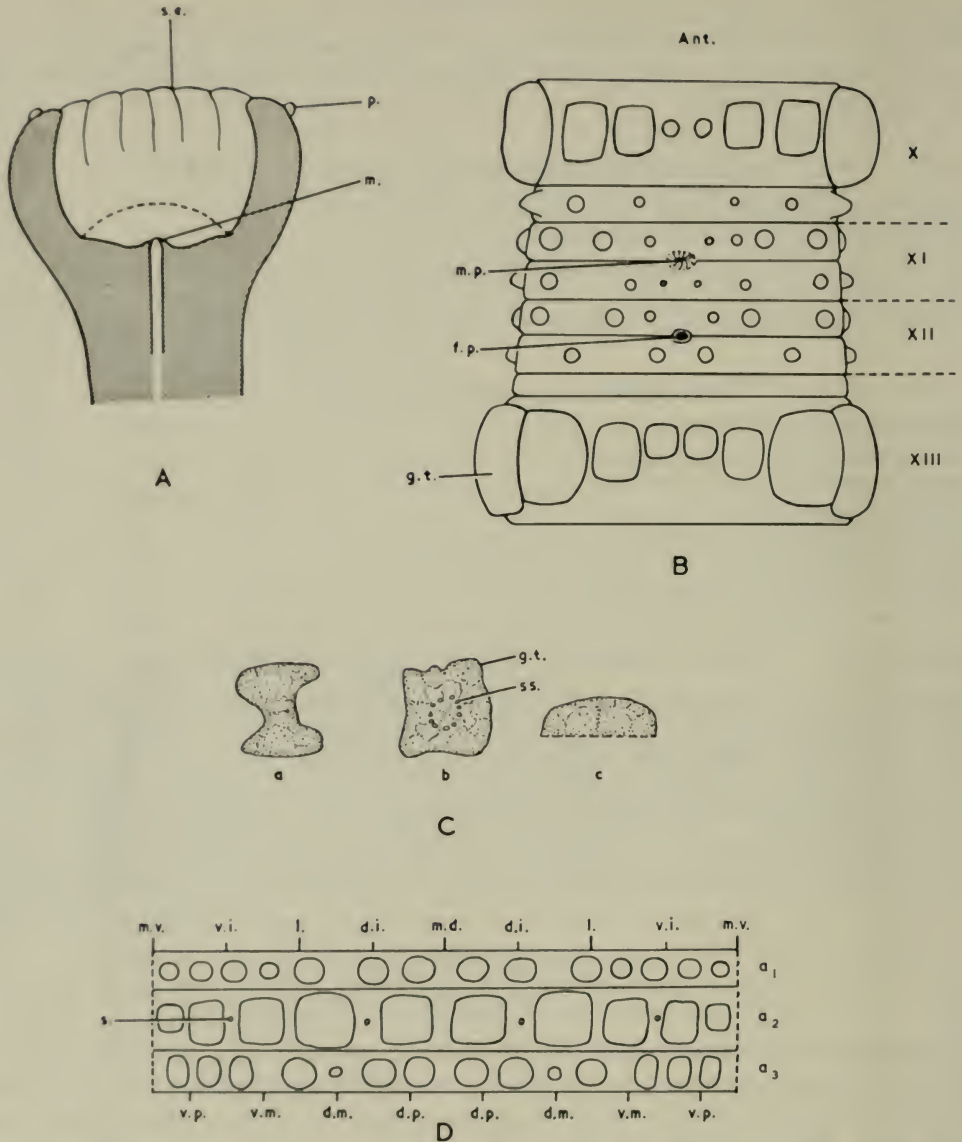


FIG. 11. *Stibarobdella macrothela*. A. Section through anterior sucker, showing oral surface. B. Ventral surface of clitellar constriction, showing positions of genital pores and tubercles. C. (a, b and c). Glandular or furrowed tubercles. D. Tuberculation of a typical triannulate somite split mid-ventrally. For designations of annuli (i.e. *a<sub>1</sub>*, *a<sub>2</sub>* and *a<sub>3</sub>*) see Mann, 1953. X–XIII, numbering of somites; *Ant.*, anterior end; *d.i.*, dorsal intermediate line; *d.m.*, dorso-para-marginal line; *d.p.*, dorso-para-median line; *f.p.*, female pore; *g.t.*, furrowed tubercle; *l.*, lateral line; *m.*, mouth; *m.d.*, mid-dorsal line; *m.p.*, male pore; *m.v.*, mid-ventral line; *p.*, papilla; *s.e.*, scalloped edge; *ss.*, sensilla; *v.i.*, ventral intermediate line; *v.m.*, ventro-para-marginal line; *v.p.*, ventro-para-median line.

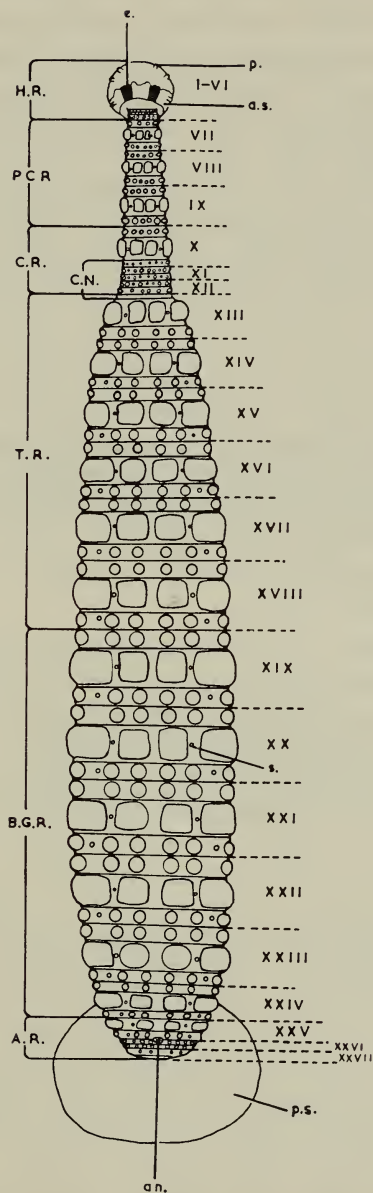


FIG. 12. Dorsal view of *Stibarobdella macrothela* showing annulation, tuberculation and suckers. I-XXVII, numbering of somites; an., anus; A.R., anal region; a.s., anterior sucker; B.G.R., caecal region (blind-gut region); C.N., clitellar constriction; C.R., clitellar region; e., pigment eye patches; H.R., head region; p., papilla; P.C.R., pre-clitellar region; p.s., posterior sucker; s., small white tubercle; T.R., testicular region.



head region. Then come three trimeric somites forming the "preclitellar region". As already remarked (page 401) most of the first somite of the "clitellar region" also lies anterior to the clitellar constriction, which extends from  $Xa_3$  to  $XIIIa_1$ . The male and female pores open on the ventral side of this constriction, between the two annuli of somites XI and XII respectively (Text-fig. 11B). In some specimens the male pore is surrounded by tumid lips. Annulus  $XIIIa_1$  is extremely small and generally lacks tubercles, whilst the other annuli of the clitellar constriction are also rather small, of uniform size, and with tubercles of reduced size. Sometimes an annulus is absent from the posterior part of the clitellar constriction and this is probably annulus  $XIIIa_1$ , rather than one of the annuli of somite XII. If so, it appears that the first testicular somite XIII is then bi-annulate. The remaining five somites of the testicular region XIV to XVIII and the six of the caecal region XIX to XXIV are all trimeric and their annular widths vary in the ratio 2 : 3-4 : 2. The annulation and tuberculation of the anal region XXV to XXVII are subject to variation. The anus is situated in the furrow between somites XXV and XXVI. These are biannulate, whilst somite XXVII is usually uniannulate, but occasionally shows signs of becoming biannulate, as also observed by Cordero (1937-38). Moore (1927) described similar annulation in this region, but later (1958) described a further specimen with somite XXIV biannulate and XXV, XXVI and XXVII uniannulate. In all other respects annulation is generally the same as that described by Cordero (1937-38) and Moore (1927 and 1958).

**TUBERCULATION.** Text-fig. 13 illustrates the tuberculation of a single specimen. There is considerable individual variation, particularly affecting the smaller tubercles. The big tubercles, however, are fairly constant in number and arrangement. The tubercles on the first two annuli of the neck, which are minute, are often absent ventrally. On the ventral surface of the  $a_1$  and  $a_3$  annuli of the preclitellar region the number of tubercles varied from 4 to 7. Where odd numbers are indicated in Text-fig. 13, this was due to bilateral asymmetry and not to median tubercles. Somite XXVI and XXVII appear to have no sensillae or small white tubercles, and their annuli have more tubercles dorsally and few or none ventrally.

Text-fig. 11D shows a typical triannulate somite of the testicular or caecal region. Here and generally throughout the body, the dorsal tubercles are larger than the ventral ones. Numbers and sizes of tubercles are reduced towards the extremities of the body. These vary considerably in shape and size depending on extent of gorging, but the four large tubercles on the dorsal surface of the  $a_2$  annuli differ from those of any other species examined (Text-figs. 11Ca, b and c). They are generally more or less square, occasionally with lateral indentations making them somewhat "H" shaped (Text-fig. 11Ca). They generally appear rather like cotton wool in texture and somewhat furrowed, and sometimes bear an apical ring of small sensillae.

In addition to these large tubercles there are generally four small white tubercles without papillae, which are difficult to see in starved specimens, two situated dorso-laterally and two ventro-laterally. The tubercles of  $a_1$  and  $a_3$  are generally more rounded and more like tubercles of other Pontobdellinae, although they too may possess rather irregular surfaces and small apical sensillae. The tubercles on the



clitellar constriction are very small and rounded. Annulus XIIIa<sub>1</sub> lacks tubercles, but the other annuli of the clitellar constriction may possess up to eight both dorsally and ventrally. The size, position and number of these vary considerably.

REMARKS. *Hirudo indica* Linnaeus (= *Pontobdella indica*: de Blainville, 1827) may well have been this species (Harding, 1927). According to Cordero (1937-38) *Pontobdella moorei*, *Pontobdella bimaculata*, *Pontobdella zonata* and *Trachelobdella carajbica* are synonymous with *Pontobdella macrothela*. However, Oka (1929), in his comparison of the external morphology of *P. moorei*, *P. bimaculata* and *Pontobdella muricata*, never mentioned irregularly shaped tubercles, and these are known to be absent from *P. muricata* and were not illustrated in the diagrams of his other two species. Furthermore Cordero's view appears to require an undue degree of variation

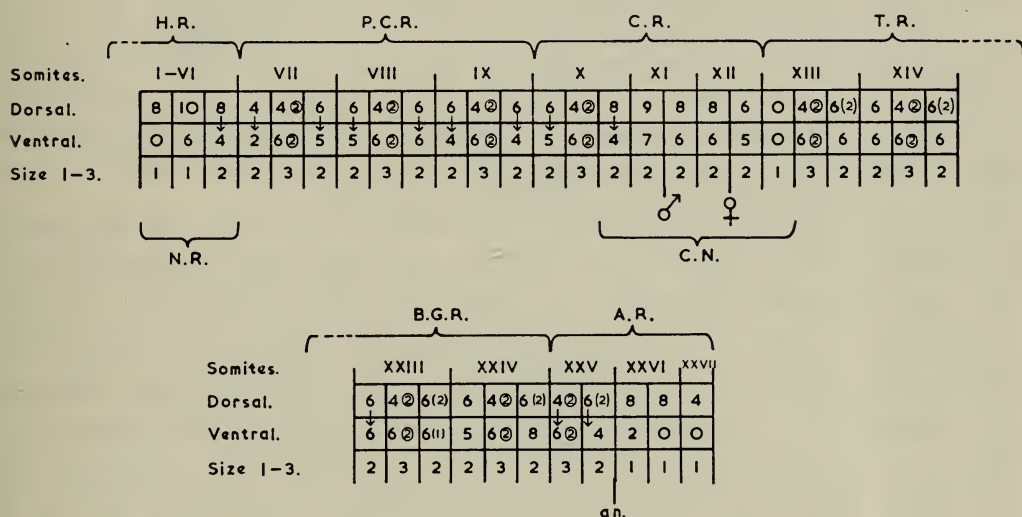


FIG. 13. Diagram illustrating the tuberculation of a single specimen of *Stibarobdella macrothela*. The anterior half is shown above, reading from left to right, H.R., head region; P.C.R., preclitellar region; C.R., clitellar region; T.R., testicular region showing first two somites; N.R., neck region; C.N., clitellar constriction where ♂ and ♀ show the position of the respective pores. The posterior half is shown below including, reading from left to right, B.G.R., caecal region (blind-gut region); A.R., anal region; an., anus. The numbers of tubercles dorsally and ventrally on each annulus are indicated in the squares. Where mid-lateral tubercles are present this is indicated by a small arrow pointing downwards, to indicate that two of the tubercles counted as dorsal are actually mid-lateral. In this species numbers in brackets indicate small secondary tubercles which are situated para-marginally (terms such as this are illustrated in Fig. 11D). Numbers in a circle indicate the presence of small white tubercles which are in the intermediate line of the dorsal and ventral region of the annulus and usually visible laterally. There are no median tubercles in normal annuli. The size range 1-3, 3 being the largest, indicates the relative size of the annulus (and tubercles) compared with the annulus next to it. It does not attempt to indicate sizes of annuli from different parts of the body, since there is a decrease in annular size towards the body's extremities.

in the characters of the suckers, such as papillae and eyes, which appear to be fairly constant in other species. It is extremely doubtful whether either *P. moorei* or *P. bimaculata* is synonymous with *P. macrothela*.

On examining the type specimen of *Pontobdella afra* it was found to be the same as *Stibarobdella macrothela*. According to Baird (1869) tubercles are absent from the  $a_1$  and  $a_3$  annuli of the preclitellar region, and the clitellar region, but in fact they are present though much reduced in size.

Ringuelet (1944) made *Pontobdella papillata* Grube (1871) synonymous with *Stibarobdella macrothela*. *Stibarobdella superba* Leigh-Sharpe (1925), which was the type by monotypy of *Stibarobdella* Leigh-Sharpe, also appears to be synonymous with the latter so this older generic name is used in place of *Pontobdellina* Harding (1927). The earlier generic diagnosis seems, incidentally, to be more useful. On examining the type specimen of *Stibarobdella superba*, which is in a rather poor condition, it was found that the median papilla on the anterior sucker figured by Leigh-Sharpe was absent. Some of the primary tubercles on the dorsal surface bore sensillae arranged diagonally and the lateral tubercles on the  $a_1$  and  $a_3$  annuli often bore three small sensillae arranged longitudinally. However, since sensillae are highly variable and in some specimens apparently absent, there seem to be no grounds for separating this from *Stibarobdella macrothela*.

Richardson (1950), in his description of *Pontobdella benhami*, regarded the number of tubercles on the  $a_2$  annulus of the testicular and caecal region as different in his leech and *Pontobdella macrothela*, i.e. eight and twelve respectively. Actually *S. macrothela* has eight primary tubercles, with an additional mid-ventral pair of medium size, making a possible ten primary tubercles. In addition to these there are secondary tubercles situated latero-dorsally and latero-ventrally, which are often obscured by the larger tubercles on each side. These small latero-dorsal tubercles were mentioned by Ringuelet (1944), Goddard (1909), Harding (1924) and Cordero (1937-38), but those lying latero-ventrally were not mentioned. The tuberculation agrees well with Richardson's description, which states that the  $a_2$  annulus, in addition to the eight primary tubercles, may possess small tubercles without sensillae which may show clearly only on gorged specimens, and that a pair of mid-ventral secondary tubercles occur near the anterior border of the  $a_2$  annulus. So the information available suggests that *Pontobdella benhami* is a synonym of *Stibarobdella macrothela*.

Goddard (1909) described a specimen of *Pontobdella macrothela*, found in Australia, which lacked any external markings and was possibly a preserved specimen which may have lost the ocular pigment patches on the anterior sucker. Cordero (1937-38) stated that *Pontobdella macrothela* may or may not possess tentacular papillae and pigmented ocular patches, but this variation seems unlikely within a single species. It may be noted that the dimensions of the suckers varied greatly amongst the forms grouped by Cordero, which suggests that different species were involved.

**DISTRIBUTION.** Widely distributed since it is found on numerous species of sharks. Specimens examined were from Gambia, Queensland, Japan, China, Barrier Reef Australia, Freemantle, British Guiana, Malindi (Kenya) and Coiba Island (Pacific).

They have also been recorded from Tandjong, Sumatra, Jamaica, New South Wales and the Bay of Bengal.

Hosts. Black-tipped shark, *Carcharinus melanopterus*; Tiger shark, *Galeocerdo arcticus*; Hammer-head shark, *Sphyrna* sp. (Moore, 1927); *Eulamia* sp.; *Scoliodon* sp. Found attached to fins, mouth and claspers.

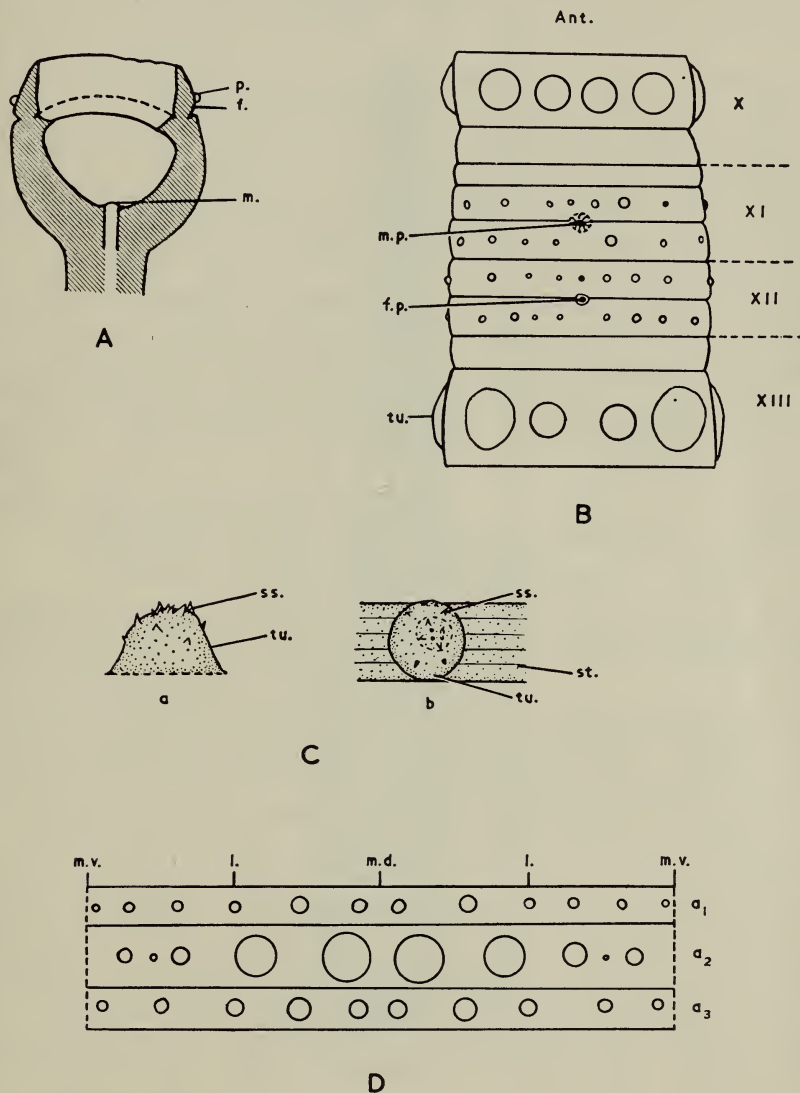


FIG. 14. *Stibarobdella loricata*. A. Section through anterior sucker, showing oral surface. B. Ventral surface of clitellar constriction, showing position of genital pores and tubercles. C. (a) Tubercle with sensillae. (b) Tubercle on annulus showing striae. D. Tuberculation of a typical triannulate somite split mid-ventrally. f., fringe; st., stria; tu., tubercle. See Fig. 11 (p. 406) for other abbreviations.

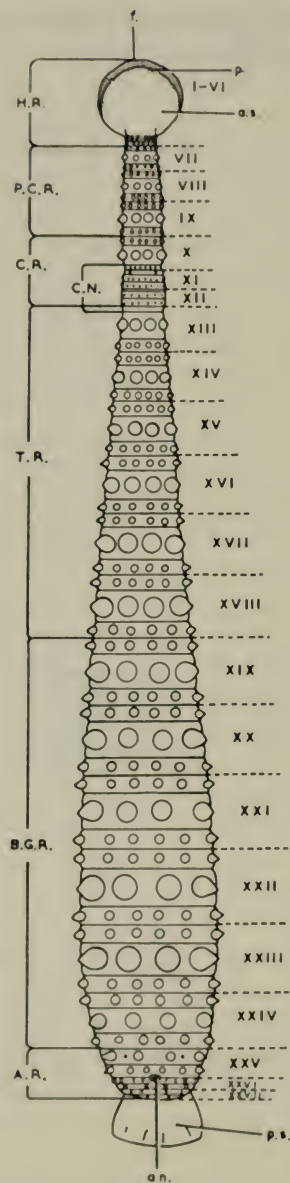


FIG. 15. Dorsal view of *Stibarobdella loricata* showing annulation, tuberculation and suckers. *f.*, fringe. See Fig. 12 (p. 407) for other abbreviations.



*Stibarobdella loricata* (Harding, 1924)

*Pontobdella loricata* Harding, 1924 : 39.

*Stibarobdella loricata* : Harant, 1929 : 651.

**DESCRIPTION.** *General Characters.* About a dozen specimens were examined. The body is fusiform, tapering gradually towards the anterior end, up to 16.6 cm. long and circular in cross-section when fully gorged, but somewhat flattened dorso-ventrally in starved specimens.

Although presumably faded, due to preservation in alcohol, and without external markings, the colour varied between pale yellow, green and brown. The anterior sucker is cup-shaped and attached eccentrically so that the dorsal surface is longer than the ventral. It is generally circular but may be slightly flattened laterally, so that its opening becomes slit-like. It possesses a marginal fringe and generally three pairs of inconspicuous papillae on each side (Text-figs. 14A and 15). The anterior sucker is often about equal in size to the posterior sucker, but when both are fully expanded the latter is slightly larger. The anterior sucker is usually three times the diameter of its point of attachment but never exceeds the greatest diameter of the body. The posterior sucker is cup-shaped when contracted and its diameter is then less than the greatest diameter of the body, but when expanded it is approximately equal to it. It is attached centrally and is greater in diameter than its point of attachment.

ANNULATION.	Uniannulate somites	} XXVII.	} XII.	(Text-fig. 15)
	Biannulate somites XXV ; XXVI			
	Triannulate somites VII-XI ; XIII-XVXI			

The first three annuli, the anterior two of which are smallest, constitute the neck. The three preclitellar somites, VII-IX, are all trimeric, with the annular and tubercular sizes of each somite in the ratio 1 : 2 : 1.

All eight annuli of the clitellar constriction, i.e.  $Xa_3$  to  $XIIIa_1$  inclusive, are greatly reduced and approximately equal in size (Text-figs. 14B and 15). Somite XI always appears to be triannulate and includes the male pore, which is situated mid-ventrally in the furrow between  $a_2$  and  $a_3$ . Somite XII is clearly divided dorsally into three annuli, but the anterior annulus is small, non-tuberculate and indistinguishable ventrally, where the female pore lies between  $a_2$  and  $a_3$ . The testicular somite XIII-XVIII are all trimeric, with annular widths and tubercular sizes in the ratio 1 : 2 : 1. The somites of the caecal region XIX-XXIV are similar, and the body is generally broadest at about somite XXII. The annulation of the three anal somites XXV-XXVII varies considerably, with annular widths decreasing towards the posterior end. Somites XXV and XXVI are biannulate and reduced ventrally. Somite XXVII may be uniannulate or biannulate. If the latter, the last annulus of the somite is generally unrecognizable ventrally. The anus is situated dorsally in the furrow between somite XXV and XXVI. Annulation and tuberculation vary towards the extremities of the body, where there is some ventral curvature.

**TUBERCULATION** (Text-fig. 16). Harding (1924 and 1927) gave the normal number of tubercles on  $a_1$  and  $a_3$  as fourteen, six dorsal, six ventral and a pair lateral, but in

my specimens the more usual number was twelve, six dorsal and six ventral, with lateral tubercles occurring rather irregularly. The number varied from ten to fourteen,  $a_3$  tending to have fewer than  $a_1$ .

The first two annuli of the neck region were extremely small and tubercles were never obvious on their ventral surfaces. In one specimen there were only five tubercles, instead of the normal six, on the dorsal surfaces of  $a_1$  and  $a_3$  annuli in the preclitellar region. The tuberculation of the clitellar constriction varied considerably and the tubercles were small and irregularly placed.  $Xa_3$ ,  $XIa_1$  and  $XIIIa_1$  were often free of tubercles, but occasionally  $XIa_1$  bore a minute pair dorsally. Most of the remaining annuli of the clitellar constriction bore between twelve and fourteen tubercles per annulus. Tuberculation of a typical trimeric somite is shown in Text-fig. 14D, the larger tubercles being dorsal in position. Small tubercles were present dorsally on the last annulus of somite XXVII, which is generally indistinguishable ventrally.

In many of the specimens each annulus possessed between four and seven striae dividing it up into smaller rings (Text-fig. 14C), but these were variable and absent in some specimens, particularly the smaller ones. Selensky (1915), in discussing the annulation of some Pontobdellinae, stated that the somite is divided into fourteen or fifteen secondary annuli. Out of the six species which I have examined, including nearly one hundred specimens, *Stibarobdella loricata* is the only species showing such subdivisions. Moreover, their presence depends on whether the specimen is gorged or starved, whereas true annuli are more permanent. Minute tubercles are never found on these small rings and a large tubercle may cover four or five of them. The

	H. R.						P. C. R.						C. R.						T. R.							
Somites.	I-VI						VII		VIII		IX		X		XI		XII		XIII		XIV					
Dorsal.	6	6	6	6	4	6	6	4	6	6	4	6	6	4	0	2	6	6	6	6	0	4	6(2)	6(1)	4	6(1)
Ventral.	0	0	4	4	4	4	2	4	4	5	4	4	6	4	0	0	7	8	7	8	0	4	6	7	4	4
Size 1-3.	1	1	2	2	3	2	2	3	2	2	3	2	2	3	2	1	2	2	2	2	1	3	2	2	3	2
	N. R.						C. N.																			

	B. G. R.										A. R.														
Somites.	XXIII					XXIV					XXV					XXVI					XXVII				
Dorsal.	6	4	6(2)	6	4	6	4	6	4	6	6	6	4	4	4	6	6	4	4	4	6	6	4	4	4
Ventral.	6(2)	4	4	6	4	5	4	4	4	4	4	4	4	2	0	1	1	1	1	1	1	1	1	1	1
Size 1-3.	2	3	2	2	3	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1
	an.																								

FIG. 16. Diagram illustrating the tuberculation of a single specimen of *Stibarobdella loricata*, anterior extremity above, posterior below. The numbers in brackets in this diagram indicate the presence of small secondary tubercles which are generally situated paramarginally. " $\frac{1}{2}$ " in the size column indicates the presence of an annulus dorsally only. See Fig. 13 (p. 409) for other abbreviations.

tubercles (Text-fig. 14*ca* and *b*) are generally quite prominent and bear sensillae, which are usually concentrated at the summits but may be present over the whole tubercle.

**DISTRIBUTION.** Off Cabinda, West Coast of Central Africa ; West Coast of Mexico and Peru ; India ; Sierra Leone and Philippine Islands.

**HOSTS.** Unrecorded but the wide distribution suggests oceanic sharks.

***Stibarobdella bimaculata* (Oka, 1910)**

*Pontobdella bimaculata* Oka, 1910 : 171.

**DESCRIPTION.** *General characters.* One specimen examined. This species is very close to *Stibarobdella tasmanica* (p. 420), but may provisionally be regarded as separate. Only one specimen was found in the British Museum collection and this resembled Oka's (1910 and 1927) description very closely. Harant (1929) seems to be wrong in assuming this to be a quadriannulate form. In this specimen the body is elongated, distended, flattened and brown, but in Oka's it was cylindrical and yellow. The specimen was 3 cm. long and 5 mm. wide.

The anterior sucker (Text-figs. 17*A* and 18) is circular, attached eccentrically, and separated from the body by a neck. The diameter of this sucker in the contracted state is slightly broader than the preclitellar region, but according to Oka it may be nearly twice as broad when expanded. It carries three pairs of marginal elongated papillae, a smaller pair situated near the base of the sucker, and a pair of large rectangular eye patches of a dark reddish brown colour. A few concentric grooves can be seen at the base of the sucker. The posterior sucker is bell-shaped, scarcely larger than the anterior sucker and separated from the body by a constriction.

ANNULATION.	Uniannulate somites	XXVII	(Text-fig. 18)
	Biannulate somites	XXV, XXVI	} XI, XII, (VII?).
	Triannulate somites	VIII-X, XIII-XXIV	

The posterior limit of the neck is doubtful in this species, since Oka (1927) called the third and fourth annulus a double annulus because they were usually poorly separated. But it seems doubtful whether both these two annuli should be regarded as lying in the neck region, making a total of four annuli there, for that would involve regarding the first preclitellar somite VII as biannulate, with the anterior annulus the largest, whereas it is triannulate in other *Stibarobdella*. The other two preclitellar somites VIII and IX are triannulate with their annular widths 1 : 2 : 1.

Of the annuli in the clitellar constriction,  $Xa_3$  is very small. Somites XI and XII may be regarded as biannulate, with the anterior annulus double, forming a smaller anterior ring, which can scarcely be regarded as a separate annulus. The male pore is situated mid-ventrally in the furrow between the two major annuli of somite XI, while the female pore is similarly situated in somite XII. Annulus  $XIIIa_1$  is very small. Somites XIV to XXIV are all triannulate, with annular widths in the ratio 2 : 3 : 2. The outline of the nerve chain could be made out on the ventral surface, with the ganglia on the  $a_2$  annulus of each somite. Somites XXV and XXVI are



biannulate, with the anus situated dorsally on the  $a_1$  annulus of somite XXVI. Somite XXVII is very small and indistinguishable ventrally, but according to Oka (1927) may be double.

**TUBERCULATION** (Text-fig. 19). In the clitellar constriction, annuli  $Xa_3$  and  $XIIIa_1$  possess no tubercles and all the other tubercles of this region are small. The tuberculation on somites VIII, IX and XIV–XXIV is fairly constant (see also Text-fig. 17c). The  $a_2$  annulus of a typical somite has four large dorsal tubercles and four smaller ventral ones, and the  $a_1$  and  $a_3$  annuli generally have six dorsal and four slightly smaller ventral ones. The tubercles are conical, generally with between six and ten apical sensillae.

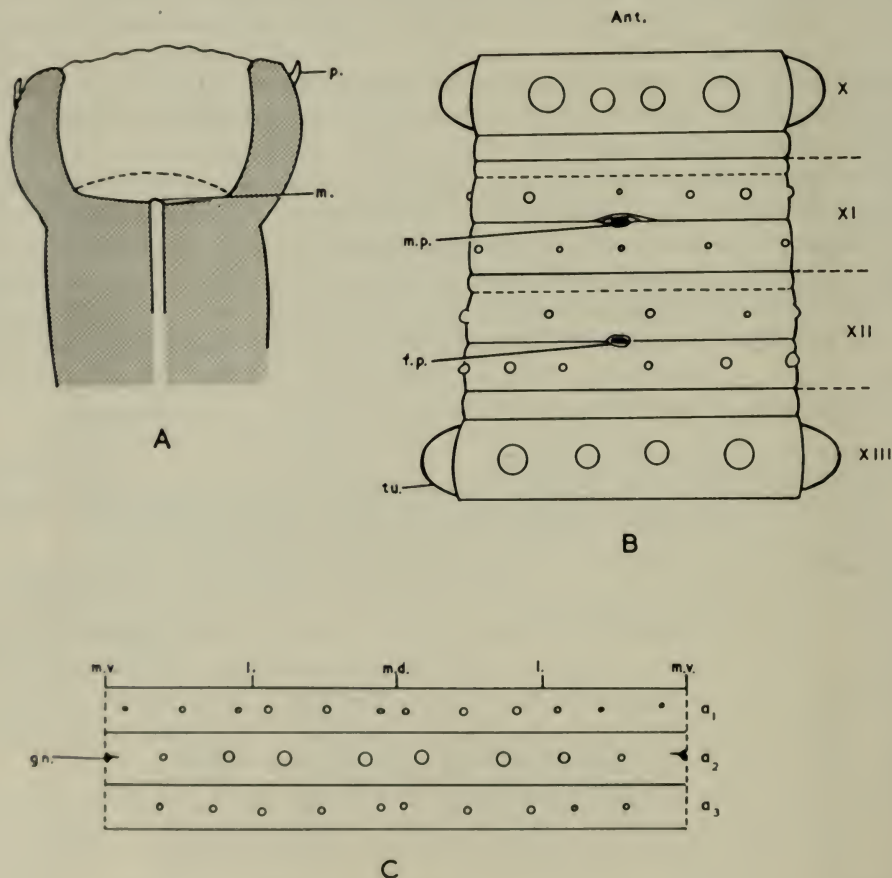


FIG. 17. *Stibarobdella bimaculata*. A. Section through anterior sucker, showing oral surface. B. Ventral surface of clitellar constriction, showing position of genital pores and tubercles. C. Tuberculation of a typical triannulate somite split mid-ventrally. *gn.*, outline of ganglion on ventral surface; *tu.*, tubercle; See Fig. 11 (p. 406) for other abbreviations.



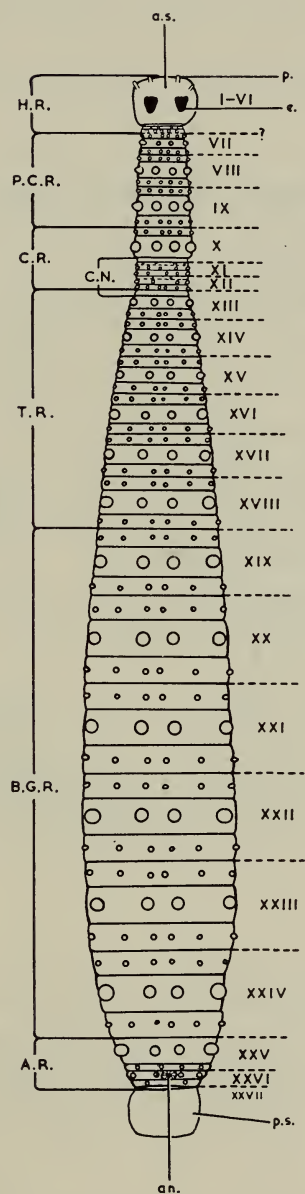


FIG. 18. Dorsal view of *Stibarobdella bimaculata* showing annulation, tuberculation and suckers. See Fig. 12 (p. 407) for abbreviations.

REMARKS. Both *Stibarobdella bimaculata* and *S. moorei* (p. 422) differ from *S. macrothela* in having the posterior sucker only slightly wider than the anterior sucker and only eight tubercles on the a<sub>2</sub> annulus. Their tubercles are also very different in appearance. They should not be regarded as synonymous as suggested by Cordero (1937-38).

DISTRIBUTION. Pearl Island, Panama ; Hondo (Coast of Sagami Awa).

HOST. Sharks.

### *Stibarobdella planodiscus* (Baird, 1869)

*Pontobdella planodiscus* Baird, 1869 : 312.

*Pontobdella variegata* Baird, 1869 : 313.

DESCRIPTION. *General characters.* Three specimens were examined, 40-55 mm. in length and 5-7 mm. in breadth. The body is elongated, yellowish and cylindrical or flattened. Baird (1869) named the cylindrical specimens *Pontobdella variegata*, but in fact they seem to be the same species as the flattened one, which he described as *P. planodiscus* and which has page priority.

The anterior sucker (Text-fig. 20A) is circular and attached eccentrically with its dorsal surface elongated. It is less than twice as broad as the neck at its narrowest point. It bears four pairs of papillae, of which the ventral pair are very small and often difficult to see, and no marginal fringe.

The posterior sucker when contracted is equal in width to its point of attachment and separated from the body only by a shallow groove, but when expanded is half

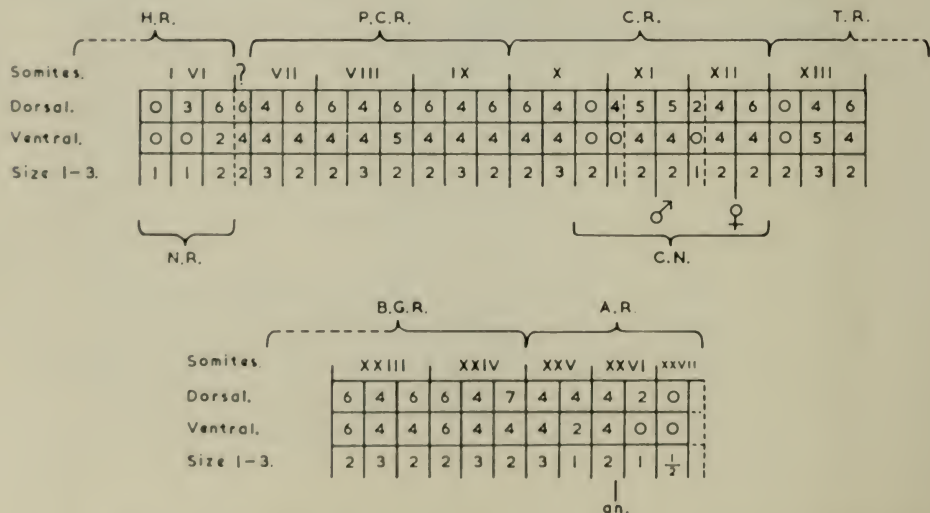


FIG. 19. Diagram illustrating the tuberculation of a single specimen of *Stibarobdella bimaculata*, anterior extremity above, posterior below. ? indicates where the limits of the somites are uncertain. "1/2" in the size column indicates the presence of an annulus dorsally only. See Fig. 13 (p. 409) for other abbreviations.

as broad again (Text-fig. 20B). The anterior : posterior sucker ratio when contracted is 1 : 1 : 6.

ANNULATION. Uniannulate somites XXVI, XXVII.

Biannulate somites XI, XII, XXV.

Triannulate somites VII-X, XIII-XXIV.

The three preclitellar somites VII-IX are triannulate, with annular widths in the ratio 2 : 3 : 2. The clitellar constriction (Text-fig. 20c) is made up of small annuli with somites XI and XII biannulate. The male and female pores lie in the grooves between the two annuli of somites XI and XII respectively. Somites XIV to XXIV are all triannulate, with their annular widths in the ratio 2 : 3 : 2. The first anal somite XXV is biannulate, with the anus situated mid-dorsally on the first annulus. Somites XXVI and XXVII consist of single small annuli which are reduced further ventrally.

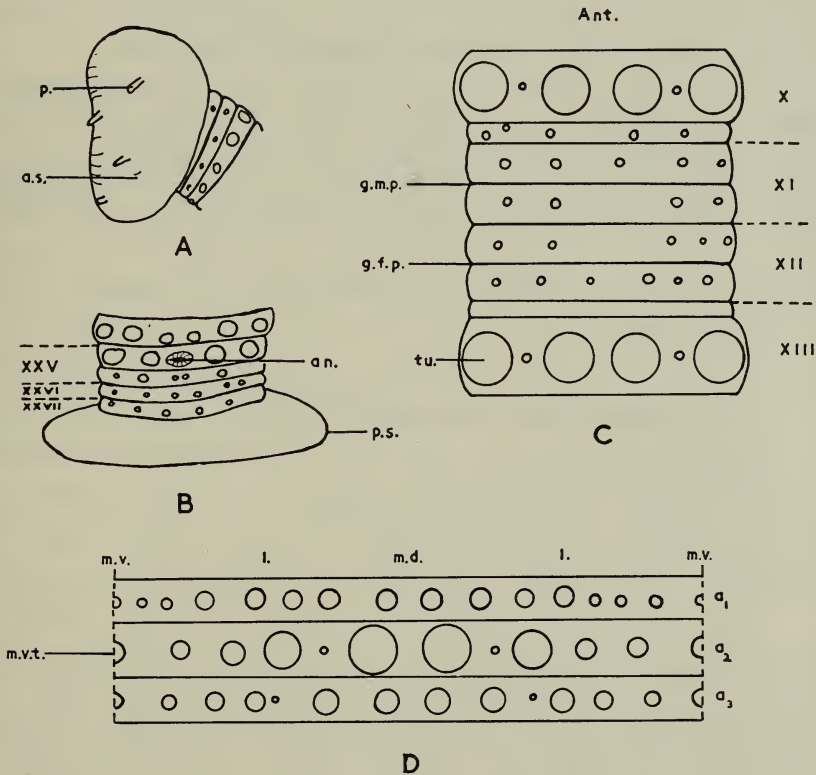


FIG. 20. *Stibarobdella planodiscus*. A. Anterior sucker. B. Posterior sucker. C. Dorsal surface of clitellar region. D. Tuberculation of a typical triannulate somite split mid-ventrally. an., anus; a.s., anterior sucker; g.f.p., groove in which female pore is situated; g.m.p., groove in which male pore is situated; m.v.t., mid-ventral tubercle; p.s., posterior sucker; tu., tubercle. See Fig. 11 (p. 406) for other abbreviations.

**TUBERCULATION.** The normal triannulate somite (Text-fig. 20D) has nine tubercles on the  $a_2$  annulus, four large tubercles situated dorsally and five smaller ventrally, of which one is mid-ventral. The  $a_1$  annulus possesses between fourteen and sixteen tubercles and the  $a_3$  annulus generally eleven. The ventral tubercles in both cases are smallest. Tubercles on annuli in the clitellar constriction are much smaller, more irregular in number and absent from the  $XIIIa_1$  annulus. Tubercles are also small and irregular on the last three annuli of the anal region and are often indistinguishable on the ventral side of the annulus of somite XXVII. The tubercles are mammiform, with sensillae at their summit.

**REMARKS.** It appears that the two species described by Baird (1869) as *Pontobdella variegata* and *Pontobdella planodiscus* are the same. According to Baird the major differences were that *P. planodiscus* had a flattened body, apical sensillae on the tubercles and three pairs of papillae on the anterior sucker, while *P. variegata* had a cylindrical body, rounded tubercles and no papillae. However, examination of his material, including the cotypes, showed that the flattening of *P. planodiscus* was similar to that seen as a preservation artefact in otherspecies and that the anterior sucker had three pairs of large papillae and one pair of small ones. Three pairs of retracted papillae were also discernible on *P. variegata*. Since the presence of sensillae at the summit of tubercles is also highly variable, there seems from the material available to be no reason for regarding these as separate species.

The sucker characters and mid-ventral tubercles of *Stibarobdella planodiscus* are similar to those of the quadriannulate form *Pontobdella vosmaeri*, indicating parallel evolution.

**DISTRIBUTION.** Straits of Magellan ; Possession Bay, Patagonia.

**HOST.** Not recorded.

### *Stibarobdella tasmanica* (Hickman, 1946)

*Pontobdella tasmanica* Hickman, 1946 : 27, nom. nov. pro *Pontobdella verrucosa* Hickman, 1941 : 41 (non *Hirudo verrucosa* Fleming, 1811 : 245).

**DESCRIPTION.** *General characters.* (Specimens not examined. Apparently originally described from a single specimen, although Ingram (1957) described further specimens.) Body 37 mm. long, fusiform, circular in section and narrowing anteriorly. Colour light brown, becoming mustard yellow on preservation. Single dark brown triangular patch on the dorsal side of the anterior sucker. Large tubercles tipped with white and apparently mammiform. Anterior sucker 2.26 mm. in diameter, cup-shaped, eccentrically attached and with four pairs of submarginal papillae and twelve radial furrows on its oral surface. No eyes. Posterior sucker cup-shaped, 3.54 mm. in diameter, centrally attached and slightly wider than the greatest width of the body. Anterior : posterior sucker ratio between 1 : 1 and 1 : 2

**ANNULATION.** Uniannulate somites XXVII } XXV, XXVI. (Somites numbered  
Biannulate somites X-XII } as in *S. macrothela*,  
Triannulate somites VII-IX, XIII-XXIV. Text-fig. 12.)



Somites of the testicular and caecal regions have annular widths in the ratio 2 : 3 : 2. Clitellar constriction between  $a_2$  annuli of somites X and XIII, consisting of five narrow rings. Male pore originally described as lying in furrow between somite XI and XII, but according to Ingram (1957) opening between  $XIa_2$  and  $a_3$ , suggesting that this somite is triannulate. Female pore in furrow between somite XII and XIII. Somite XXV divided into two annuli only ventrally and somite XXVI divided into two only dorsally. Anus near posterior edge of annulus  $XXVIa_1$ .

**TUBERCULATION.**  $A_2$  annuli each possess four large dorsal tubercles and four smaller ventral ones.  $A_1$  and  $a_3$  annuli have six dorsal and six ventral tubercles with the two dorso-median tubercles smallest, and a ventro-median tubercle often present. Interposed tubercles common.

**DISTRIBUTION.** Sandy Bay, Hobart ; Kingston, Jamaica ; Brig Rocks, King Island.

**HOST.** Skate (Ingram, 1957).

***Stibarobdella taprobanensis* (de Silva, 1963)**

*Pontobdella taprobanensis* de Silva, 1963b : 39.

**DESCRIPTION.** *General characters.* (Specimens not examined.) Body up to 29 mm. long (including suckers). Preclitellar region translucent (enabling underlying organs to be seen). Rest of body yellowish brown, with pairs of brown spots dorsally on testicular and caecal region. Anterior sucker deeply cupped and slightly wider than preclitellar region, with dorsal margin three times the length of ventral margin, incised, shovel shaped, and bearing dorsally a pair of vermilion coloured blotches which meet anteriorly and two pairs of eyes, but no papillae. Anterior : posterior sucker ratio between 1 : 1.3 and 1 : 2. Posterior sucker with dark radial bands and a smooth margin, oval, sometimes folded dorso-ventrally, eccentrically attached, so that the dorsal portion is twice the ventral portion, and equal to or less than the maximum diameter of the body.

**ANNULATION AND TUBERCULATION.** Uniannulate somites (XXV–XXVII)?

Biannulate somites XI, XII.

Triannulate somites VII–X, XIII–XXIV.

(Somites numbered as in *S. macrothela*,  
Text-fig. 12.)

No true tubercles, but only slightly protuberant opaque patches, segmentally arranged. Two small neck annuli. Preclitellar annuli VII–X triannulate,  $a_2$  annuli largest and possessing two opaque patches dorso-laterally and two ventro-laterally, composed of groups of small opaque spots, which are distributed sparsely elsewhere. Annuli  $a_1$  and  $a_3$  possess a pair of opaque patches dorsally only. Preclitellar constriction in usual position, between  $Xa_3$  and  $XIIIa_1$ . Somite XI and XII without opaque patches. Male pore mid-ventral, in the middle of somite XI. Female pore mid-ventral, in middle third of somite XII.  $A_2$  annuli of somites XIII–XXIV with two pairs of opaque patches (rosettes) dorsally, situated para-marginally

and para-medially, and composed of two to six triangular opaque areas. Mid-dorsal ellipsoidal umber coloured clear areas on all annuli. No rosettes ventrally or on somites posterior to somite XXIV. Anus mid-dorsal between somites XXVI and XXVII.

DISTRIBUTION. Wadge Bank, Ceylon.

HOST. Unknown.

*Stibarobdella moorei* (Oka, 1910)

*Pontobdella moorei* Oka, 1910 : 171.

*Stibarobdella moorei* : Harant, 1929 : 651.

DESCRIPTION. *General characters.* (Specimens not examined.) Body up to 14 cm. long and 14 mm. broad, fusiform, yellowish and thickest in the middle of the posterior half. Anterior sucker smooth, hemispherical, rather large, and without fringe, eyes, papillae or annular marks. Posterior sucker bell-shaped, scarcely larger than anterior sucker and separated from the body by a constriction.

ANNULATION. Uniannulate somites—none.

Biannulate somites XI, XII, XXV–XXVII. (Somite numbering as

Triannulate somites VII–X, XIII–XXIV. in *S. macrothela*,  
Text-fig. 12.)

Triannulate somites have annular widths in the ratio 3:4:3. Neck of three annuli, the posterior largest and the anterior two often hidden by sucker. Pre-clitellar region of three triannulate somites. Clitellar constriction as usual between  $a_2$  annuli of somites X and XIII. Somites XI and XII biannulate and bearing between their annuli the male and female pores respectively. Somites XXV–XXVII biannulate, becoming smaller posteriorly. Anus on  $a_1$  or between  $a_1$  and  $a_2$  of somite XXVI.

TUBERCULATION.  $A_2$  annuli with four prominent tubercles dorsally and four ventrally, each bearing 7–10 apical sensillae.  $A_1$  and  $a_3$  annuli with ten smaller tubercles, four dorsally, four ventrally and two laterally. Tubercles on clitellar constriction are smaller still and absent from annulus  $Xa_3$  and sometimes from  $XIIIa_1$ .

DISTRIBUTION. Hondo (Coast of Sagami, Awa). Coast of Tokyo.

HOST. Shark.

*Stibarobdella australiensis* (Goddard, 1909)

*Pontobdella australiensis* Goddard, 1909 : 724.

DESCRIPTION. *General characters.* (Specimens not examined.) Body up to 20 mm. long and 3 mm. broad, attenuated anteriorly and circular in cross-section, extremities yellowish brown, the rest bluish grey. Anterior sucker 1 mm. in diameter, with four or five pairs of papillae (the posterior pair inconspicuous or absent), two faint annuli on dorsal surface and no fringe or pigmented markings. Posterior sucker 1.5 mm. in diameter, with five or six annuli on dorsal surface. Anterior : posterior sucker ratio 1 : 1.5.

## Biannulate somites

XI, XXV, XXVI }

XXII, XXVII

(Somite numbering as for *S. macrothela*, Text-

Triannulate somites VII-X, XIII-XXIV fig. 12.)

**TUBERCULATION.** Tubercles largest in the testicular and caecal regions, where the  $a_2$  annuli each bear six prominent conical papillae, four dorsal, situated para-medially and para-marginally, and two ventral, situated para-marginally. These ventral tubercles are smaller and similar in size to tubercles of  $a_1$  and  $a_3$  annuli. Dorsal tubercles are larger than  $a_1$  and  $a_3$  tubercles.

DISTRIBUTION. Not recorded.

Host. Not recorded.

Genus *PONTOBELLA* Leach, 1815

*Pontobdella* Leach, 1815 : 9.

TYPE SPECIES. *Hirudo muricata* Linnaeus.

DIAGNOSIS. Somites of the testicular and caecal regions tetrameric.

*Pontobdella muricata* (Linnaeus, 1758)

*Hirudo muricata* Linnaeus, 1758 : 650.

*Hirudo verrucosa* Fleming, 1811: 245.

*Pontobdella verrucata* Leach, 1815: 11.

*Pontobdella areolata* Leach, 1815: 10.

*Pontobdella spinulosa* Leach, 1815: 12.

*Pontobdella muricata*: de Blainville, 1818: 293; Harding, 1910: 143.

*Pontobdella laevis* de Blainville, 1827 : 243.

*Pontobdella verrucosa* : Leydig, 1851 : 318.

DESCRIPTION. *General characters.* (About fifty specimens examined.) The body is club-shaped, generally circular in cross-section or slightly flattened dorso-ventrally in some starved specimens, and up to 19.0 cm. long (excluding suckers). The colour varies from dull yellow to olive green or occasionally pinkish.

The cup-shaped anterior sucker (Text-fig. 21A and 22) is between two and three times the diameter of the neck and is generally as large as or larger than the posterior sucker. It is circular and fixed eccentrically, so that the dorsal surface is longer than the ventral. Around its edge is a very noticeable fringe, bearing three pairs of lateral papillae, which are sometimes retracted and obscure. The sucker may be somewhat flattened laterally and then appears to have a slit-like opening.

The posterior sucker is cup-shaped when contracted, centrally fixed and generally just broader than its point of attachment, although considerably larger when expanded. It never exceeds the maximum diameter of the body.



ANNULATION. Uniannulate somites —

Biannulate somites XI, XII, XXV, XXVI, XXVII.

Triannulate somites VII–X.

Text-fig. 22.

Quadriannulate somites XIII–XXIV.

The first three annuli constitute the neck and the anterior two of these are much smaller than the other. The three preclitellar somites VII–IX are all triannulate with their annular and tubercular sizes in the ratio 1 : 2 : 1. The clitellar constriction includes the small annuli  $Xa_3$  and  $XIIIa_1$ , between which are from four to six annuli,

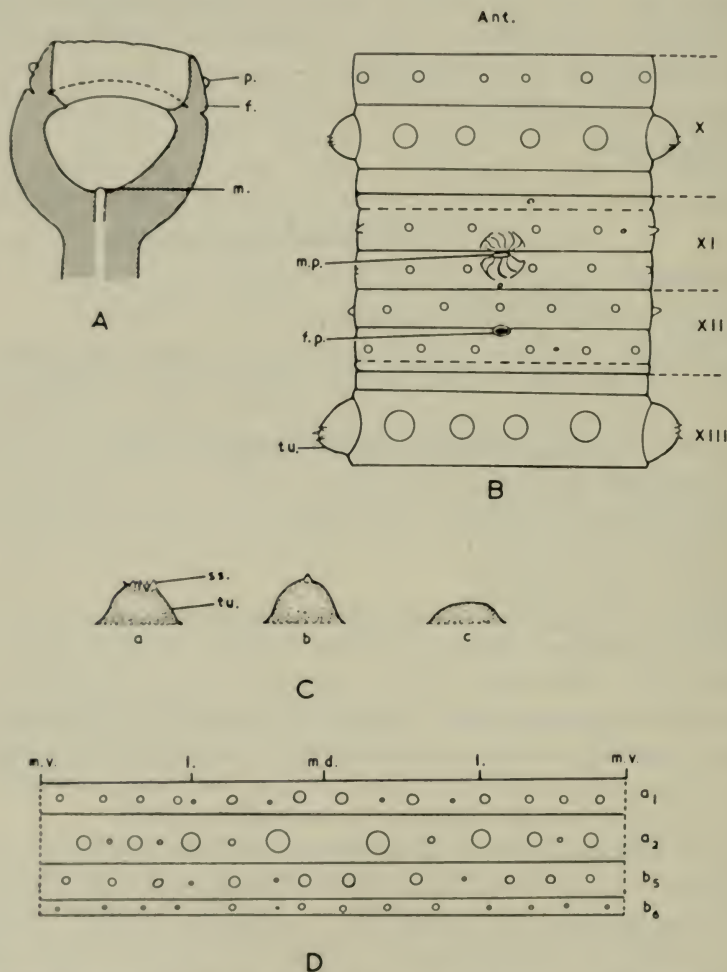


FIG. 21. *Pontobdella muricata*. A. Section through anterior sucker, showing oral surface. B. Ventral surface of clitellar constriction, showing position of genital pores and tubercles. C. a, b and c: Tubercles in various stages of contraction. D. Tuberculation of a typical quadriannulate somite split mid-ventrally. For designation of annuli, i.e.  $a_1$ ,  $a_2$ ,  $b_5$  and  $b_6$ , see Mann 1953; f., fringe; tu., tubercles; See Fig. 11 (p. 406) for other abbreviations.



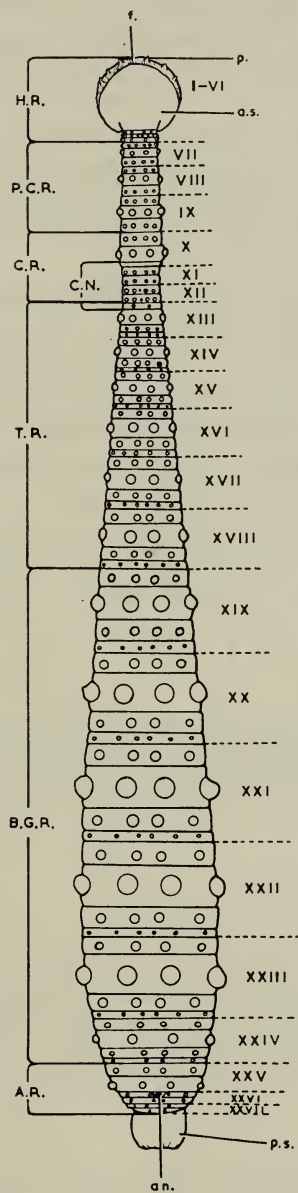


FIG. 22. Dorsal view of *Pontobdella muricata* showing annulation, tuberculation and suckers. *f.*, fringe; See Fig. 12 (p. 407) for other abbreviations.

two or three per somite (see dotted lines in Fig. 21D). The appearance of these extra subdivisions may depend on the stage of gorging or contraction of the specimen. The male pore is situated in the furrow between  $a_1$  and  $a_2$ , or  $a_2$  and  $a_3$  of somites XI (depending upon whether this somite is bi- or triannulate), while the female pore is situated between  $a_1$  and  $a_2$  of somite XII. Somites XIII to XXIV are all quadriannulate and their annular widths and tubercular sizes vary in the ratio of 2 : (3 or 4) : 2 : 1.

The annulation of the three anal somites XXV–XXVII is rather indistinct, but it appears that there are two annuli per somite, decreasing in size posteriorly. The last two small annuli are often unrecognizable and nearly always absent from the ventral surface. The anus is mid-dorsal in somite XXVI, either between the two annuli, or in the middle of the anterior annulus.

**TUBERCULATION.** Text-fig. 23 shows the arrangement of tubercles towards the anterior and posterior extremities of the body. Text-fig. 21D shows the tuberculation of a typical quadriannulate somite. Dorsal tubercles tend to be larger than ventral ones. The  $a_2$  annulus has eight primary tubercles, between which may lie 0–6 secondary tubercles. The  $a_1$  annulus has generally about twelve primary tubercles and up to six secondary tubercles. The  $b_5$  annulus has about ten primary tubercles and up to six secondary tubercles, and the  $b_6$  annulus about fourteen small tubercles.

The tubercles on the first two small annuli of the neck region are much reduced and often absent from the ventral surface. In the clitellar constriction the tubercles are much reduced and irregular in arrangement. Annuli  $Xa_3$  and  $XIIIa_1$  often have

	H.R.						P.C.R.						C.R.						T.R.										
Somites.	I-VI						VII		VIII		IX		X		XI		XII		XIII				XIV						
Dorsal.	4	8	4	6	4	4	4	4	4	4	4	3	3	4	↓	4	4	5	5	2	4	4	4	4	4	4	3	4	
Ventral.	0	0	0	6	4	6	7	4	6	7	4	5	5(2)	4	↓	6	7	6	7	0	4(1)	5	6(1)	6	4	6	0	6	
Size 1-3.	1	1	2	2	3	2	2	3	2	2	3	2	2	3	2	2	2	2	2	2	3	2	1	2	3	2	1	2	
	N.R.						C.N.																						
	B.G.R.										A.R.																		
Somites.	XXIII					XXIV					XXV					XXVI		XXVII											
Dorsal.	5	4	4	6	5	4	4	4	4(2)	4	4	4	4	4	2	(2)													
Ventral.	7	4	6	4	7	4	6	4	4(6)	6	4	2	2	0	0														
Size 1-3.	2	3	2	1	2	3	2	3	2	1	2	1	1	1	1														
	an.																												

FIG. 23. Diagram illustrating the tuberculation of a single specimen of *Pontobdella muricata*, anterior extremity above, posterior below. The numbers in brackets in this diagram indicate a regular increase in numbers of tubercles found in this region in other specimens. Secondary tubercles are not indicated here because of their irregularity. "½" in the size column indicates the presence of a small annulus dorsally only. See Fig. 13 (p. 409) for other abbreviations.

no tubercles, and when present these are more usually found dorsally. In the anal region too, tubercles are few or absent on the ventral surfaces of the annuli.

REMARKS. Harding (1910) observed that the shape of the tubercles can vary considerably depending on whether the leech is relaxed, gorged or otherwise (Fig. 21*a, b, c*). According to Selensky (1915), muscle fibres can pull down the tips of the tubercles, so that the skin becomes smooth. This has led to considerable confusion and the erection of numerous invalid species. *Pontobdella muricata* was described as having tubercles possessing a rosette of sensillae on their summit, *P. verrucata* as having mammiform tubercles without a rosette of sensillae, *P. areolata* as having tubercles forming low irregular prominences and *P. laevis* as having entirely retracted tubercles. It is possible, however, that *P. laevis* is not one of the Pontobdellinae (Moquin-Tandon, 1846).

*Pontobdella verrucosa*, according to Moquin-Tandon (1846) was distinguished by each quadriannulate somite having one large annulus and three small annuli, compared with three large annuli and one small in *P. muricata*. There are no grounds for the former species, since in fact *P. muricata* somites usually have one large annulus  $a_2$ , two medium sized annuli  $a_1$  and  $b_5$ , and one small annulus  $b_6$ .

DISTRIBUTION. Mediterranean Sea, North Sea and most waters in north-east Atlantic.

HOSTS. Many species of rays and sometimes plaice.

### *Pontobdella vosmaeri* Apathy, 1888.

*Pontobdella vosmaeri* Apathy, 1888 : 59.

*Pontobdella brumpti* Rivière, 1925 : 292.

DESCRIPTION. *General characters.* (Five specimens examined.) The body is club-shaped, circular in cross-section and may reach a length of 7.5 cm. (excluding suckers). The colour is dull yellow and usually uniform. The neck region is only slightly smaller than the diameter of the anterior sucker, the ratio in size being about 1 : 1.3. The anterior posterior sucker ratio is about 1 : 2. The anterior sucker (Text-fig. 24*A* and 25) is circular, cup-shaped and fixed eccentrically, so that the dorsal surface is somewhat larger than the ventral. The margin is without a fringe but generally bears three pairs of papillae. The posterior sucker is cup-shaped when contracted and fixed to the body centrally. It is generally slightly thicker than the body at its point of attachment, although when expanded it may be considerably larger, but never exceeding the maximum diameter of the body.

ANNULATION. Uniannulate somites	XXVI, XXVII.	} VII. Text-fig. 25.
Biannulate somites	XI, XII, XXV	
Triannulate somites	VIII, X	
Quadriannulate somites	XIII-XXIV	
		} IX.

The dorsal surface of the anterior sucker is sometimes faintly marked by three transverse furrows. The neck region includes the first three annuli, the anterior two of which are much smaller than the other. The annulation of the three pre-

clitellar somites is quite different from *Pontobdella muricata*. Somite VII is generally biannulate, but occasionally there is a much reduced anterior annulus. Somite VIII is triannulate with the annular widths in the ratio of 1 : 3 : 2; whilst somite IX, although generally divided by two furrows to form three annuli with widths in the ratio 2 : 3 : 2, has an extra row of tubercles on the  $a_3$  annulus, suggesting incipient subdivision. Somite X (Text-fig. 24B) is triannulate with its annular widths in the ratio of 2 : 3 : 1, the  $Xa_3$  annulus being the first annulus of the clitellar constriction. Somites XI and XII are both biannulate and the annuli are generally of equal size. The male pore is situated mid-ventrally in the furrow between the two annuli of somite XI, while the female pore is similarly situated just posterior to the furrow dividing the two annuli of somite XII. Annulus  $XIIIa_1$ , which is small and sometimes difficult to see, is the last of the clitellar constriction. Somite XIII is quadriannulate, the ratio of widths being 1 : 3 : 2 : 1. Somites XIV to XXIV are also tetra-annulate,

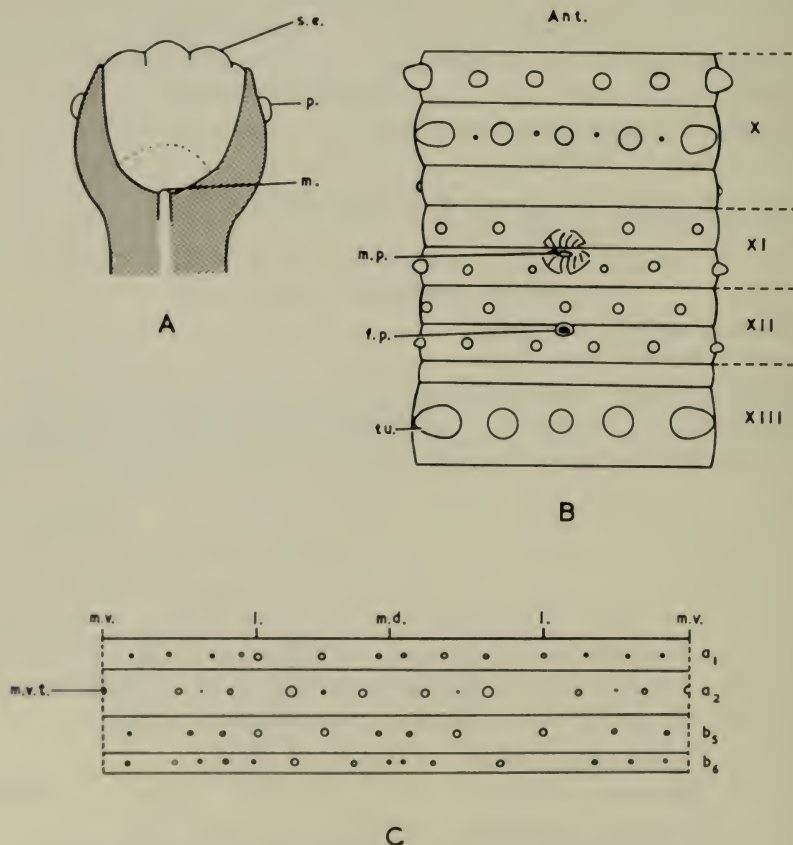


FIG. 24. *Pontobdella tosaeri*. A. Section through anterior sucker, showing oral surface. B. Ventral surface of clitellar constriction, showing position of genital pores and tubercles. C. Tuberculation of typical quadriannulate somite split mid-ventrally. *m.v.t.*, mid-ventral tubercle; *tu.*, tubercle; See Fig. 11 (p. 406) for other abbreviations.



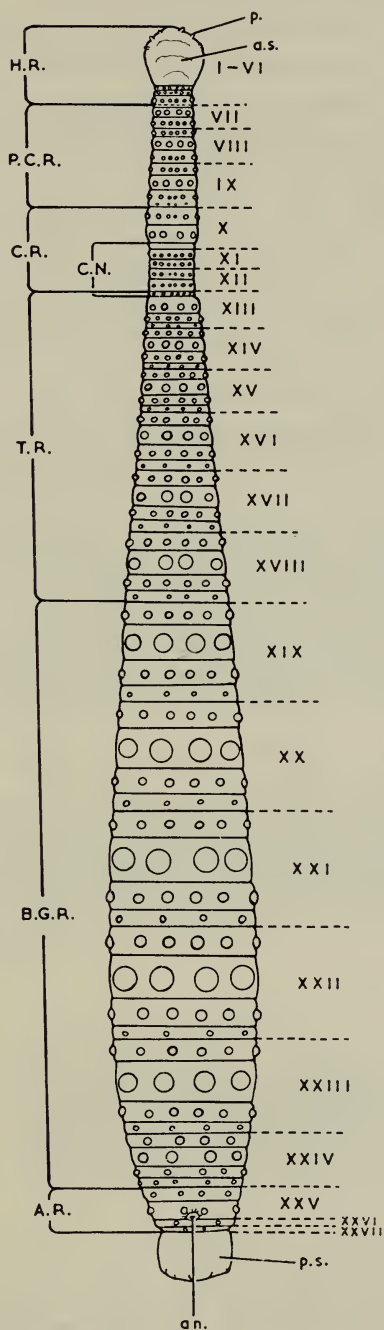


FIG. 25. Dorsal view of *Pontobdella vosmaeri* showing annulation, tuberculation and suckers. See Fig. 12 (p. 407) for abbreviations.

but with the ratio of widths and tubercular sizes 2:3:2:1. The anal somites XXV-XXVII are much reduced. Somite XXV contains two annuli of which the posterior one is largest. Both somite XXVI and XXVII appear to consist of a single annulus each, the annuli being practically absent from the ventral surface. The anus occurs either in the furrow between somite XXV and XXVI, or near the posterior edge of the  $a_2$  annulus of somite XXV.

**TUBERCULATION** (Text-fig. 26). The dorsal surface of the anterior sucker is sometimes marked by faint grooves, between which may occur seven to eight extremely small papillae. Tubercles on the first two annuli of the neck region are much reduced and generally absent from the ventral surface. Annulus IX $a_3$  has a double row of tubercles, in which the posterior row is by far the smallest. According to Rivière (1925) annulus X $a_3$ , the first annulus of the clitellar region, is non-tuberculate, but in some specimens it bears tubercles dorsally. On the other hand somite XIII $a_1$  was according to Rivière tuberculate, but in some specimens it is non-tuberculate. As these annuli are small it may be expected that their tuberculation will vary.

Text-fig. 24C shows the tuberculation of a typical quadriannulate somite. Although the secondary tubercles on the  $a_2$  annulus are subject to variation, the number of primary tubercles is constant. This species differs from *Pontobdella muricata* in having nine primary tubercles on the  $a_2$  annulus, including one situated mid-ventrally. The  $a_1$  annulus possesses about fourteen primary tubercles and a varying number of secondary tubercles, while  $b_5$  has about twelve primary tubercles

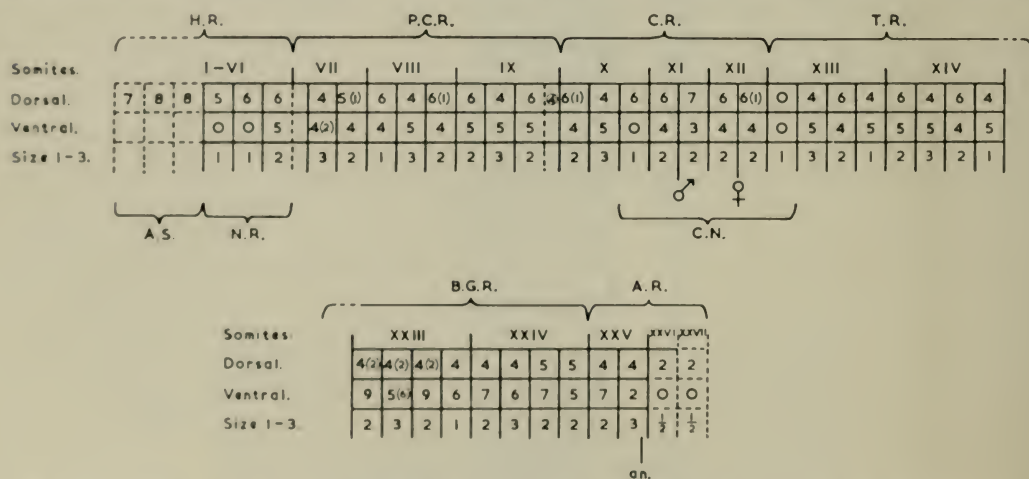


FIG. 26. Diagram illustrating the tuberculation of a single specimen of *Pontobdella voamaeri*, anterior extremity above, posterior below. A.S., region of anterior sucker. The numbers in brackets in this diagram indicate a regular increase in numbers of tubercles found in this region in other specimens. Secondary tubercles are not indicated here because of their irregularity. "1/2" in the size column indicates the presence of small annulus dorsally only. Dotted lines indicate where additional annuli may or may not be present. See Fig. 13 (p. 409) for other abbreviations.

and up to six secondary ones, rarely having a total of more than fifteen. Annulus  $b_6$  has about fourteen small tubercles. The large tubercles are generally conical, with up to eight apical sensillae, whereas small tubercles generally lack sensillae.

REMARKS. Herter (1935) suggested that *Pontobdella brumpti* Rivière (1925) appears to be synonymous with *Pontobdella vosmaeri* Apathy (1888). Although Rivière referred to Apathy, he did not mention the brief but adequate description of *P. vosmaeri*, which is placed in an addendum to the paper. It seems that Rivière overlooked this description, since he referred only to a brief description given by Blanchard (1893).

DISTRIBUTION. Plymouth, Roscoff, Capri.

HOST. Rays?

### *Pontobdella aculeata* Harding, 1924

*Pontobdella aculeata* Harding, 1924 : 491.

DESCRIPTION. *General characters.* (Specimens not examined.) Body fusiform, attenuated anteriorly and circular in cross-section. Length 35–64 mm., breadth 6–8 mm. Colour dull grey to reddish brown, occasionally with linear spots on the  $a_2$  annulus of each somite. Anterior sucker attached eccentrically, small, circular, with a corrugated edge, without papillae and apparently with no fringe. Anterior : posterior sucker ratio 1 : 1 or former slightly larger. Posterior sucker circular, with corrugated edge and attached centrally.

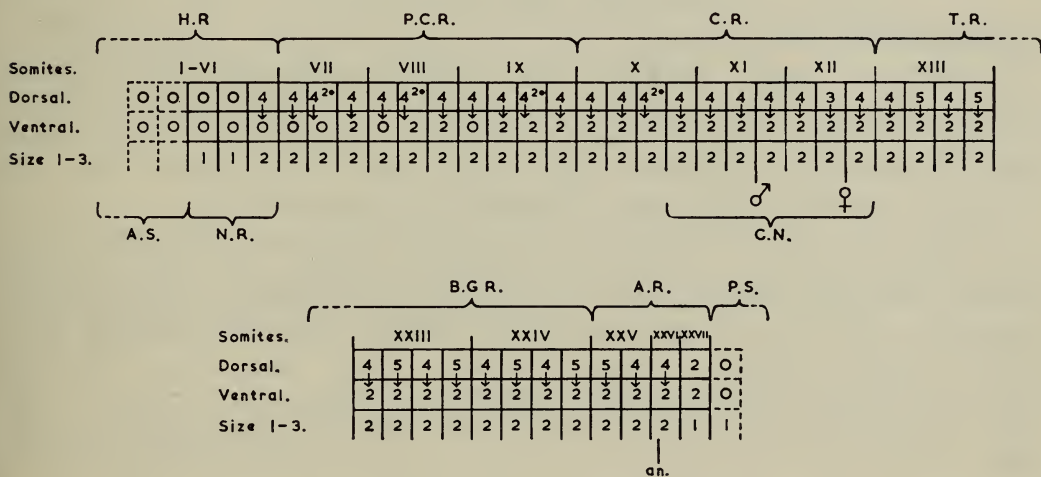


FIG. 27. Diagram illustrating the tuberculation of a single specimen of *Pontobdella aculeata*, anterior extremity above, posterior below. Compiled from the details in Harding (1924 and 1927). A.S., region of anterior sucker; P.S., region of posterior sucker. Small number in top right hand corner of square, with a black dot, denotes number of brown spots on dorsal surface of leech. See Fig. 13 (p. 409) for other abbreviations.



ANNULATION. Uniannulate somites	XXVI, XXVII.
Biannulate somites	XXV.
Triannulate somites	VII, VIII, XI, XII.
Quadriannulate somites	IX, X, XIII-XXIV.

Annuli of quadriannulate somites approximately equal in width but becoming smaller towards the extremities of body. Dorsal surface of anterior sucker may possess faint furrows. Neck possesses three annuli with ratio of widths from anterior end 1 : 1 : 2. Clitellum inconspicuous, probably comprising annuli Xb<sub>6</sub> to XIIIa<sub>1</sub>. Male pore opens mid-ventrally in furrow between XIa<sub>2</sub> and XIa<sub>3</sub>. Female pore opens mid-ventrally in furrow between XIIa<sub>2</sub> and XIIa<sub>3</sub>. Anus opens mid-dorsally on the annulus of somite XXVI.

TUBERCULATION. Text-fig. 27 shows tuberculation near the anterior and posterior extremities, derived from details given by Harding (1924 and 1927). All annuli of a quadriannulate somite possess lateral tubercles with the tubercles on b<sub>5</sub> largest. In addition, on the dorsal surface, the a<sub>1</sub> and b<sub>5</sub> annuli possess a paramedian pair, whilst the a<sub>2</sub> and b<sub>6</sub> annuli possess a para-marginal pair and a median tubercle. Ventrally there is only a para-marginal pair present on all annuli.

DISTRIBUTION. Bassein River, Burma; Gregory Isles, Mergui Archipelago, Burma; Wadge Bank, Ceylon (de Silva, 1963a).

HOST. Teleost *Harpodon nehereus*. (This fish is found in fresh water and estuaries as well as the sea.)

### *Pontobdella rugosa* Moore, 1938

*Pontobdella rugosa* Moore, 1938 : 5.

DESCRIPTION. *General characters*. (No specimens examined.) Body slender, tapering gradually from the anterior to posterior end, length about 40.5 mm., maximum breadth 2.3 mm. and slightly flattened. Striking colour pattern metamERICALLY blotched and annulated, with ground colour of ferruginous brown and pale yellow markings or vice-versa. The pattern varies considerably.

Anterior sucker sub-hemispherical, eccentrically attached so that oral surface faces ventrally, bearing a fringe (welt according to Moore), with fifty-two small papillae, two circles of sub-marginal papillae, and marked postero-dorsally by faint annulations, with rows of small papillae and pigment spots with vestigial eyes. Mouth situated centrally. Anterior:posterior sucker ratio 1:1.7. Posterior sucker cup-shaped when contracted, generally not exceeding the diameter of the body. Margin furrowed, cavity of sucker shallow, and externally rayed with brown rays.

ANNULATION. Uniannulate somites	XXVI, XXVII.	
Biannulate somites	XXV	} XII.
Triannulate somites	(VI?) XI	
Quadriannulate somites	XIII-XXIII	} } XXIV.
Sexannulate somites	VII-X	



Neck made up of four annuli, the first being small and reduced ventrally, the other three equal in size. Somites VII-X quadriannulate, with  $a_1$  and  $a_2$  tending to be biannulate. This tendency becomes more prominent posteriorly, as does the complexity and size of the somites. Clitellum ill-defined, probably extending from  $Xb_6$  to  $XIIIa_1$ . Somite XI triannulate with annular size becoming slightly smaller posteriorly. Somite XII bi- or triannulate. Male pore on annulus  $XIa_2$  and female pore in furrow between annuli  $XIIa_1$  and  $XIIa_2$  or as far forward as middle of annulus  $XIIa_1$  (i.e. in furrow between  $XIIb_1$  and  $XIIb_2$ ). Somites XIII to XXIII are quadriannulate and the annular sizes are usually  $a_1 > a_2 > b_5 = b_6$ . In somite XXIV the furrow between  $b_5$  and  $b_6$  is often indistinct. Somite XXV is biannulate, with the anterior annulus largest. Anus mid-dorsal in furrow between somite XXVI and XXVII.

**TUBERCULATION.** Text-fig. 28 shows tuberculation of the anterior and posterior regions from details given by Moore (1938), but not including small secondary tubercles, although they are said to be present in varying numbers. Tubercles are generally largest dorsally, Particularly on  $a_1$  annuli. They are small or absent on neck annuli, somite VII, the clitellar constriction ( $Xb_6$ - $XIIIa_1$ ), the anal region and  $b_6$  of somites VIII-X. There are no tubercles on the small indistinct  $b_2$  and  $b_4$  annuli of somites VII-X. Otherwise dorsally, on all  $a_1$ ,  $b_5$  and  $b_6$  annuli, there are two pairs of tubercles, outer paramedians and supra-marginals, while on  $a_2$  annuli there are a lateral pair of tubercles and a pair near the intermediate line. Ventrally,  $a_1$ ,  $b_5$  and  $b_6$  bear two pairs of (para-median and sub-marginal) tubercles, while  $a_2$  bears a single pair on the intermediate lines. The tubercles are large, pointed, conical and with one or more apical papillae.

**DISTRIBUTION.** Commonwealth Bay, King George V Land;  $66^\circ 32' S.$ ,  $141^\circ 39' E.$ , 157 fathoms;  $65^\circ 42' S.$ ,  $92^\circ 60' E.$ , 60 fathoms.

**HOST.** Not recorded.

### Genus *PENTABDELLA* gen. nov.

**TYPE SPECIES.** *Pontobdella dispar* Cordero, 1937.

**DIAGNOSIS.** Tuberculate Piscicolidae in which most of the somites of the testicular and caecal regions are pentameric.

### *Pentabdella dispar* (Cordero, 1937)

*Pontobdella dispar* Cordero, 1937: 13.

**DESCRIPTION.** *General characters.* The following description is based on that by Cordero. The body is fusiform, elongated, of circular section and a uniform pale yellow. It may be up to 160 mm. long (including suckers) and 16 mm. wide (about annulus  $XXIa_2$ ). Anterior sucker hemispherical, smooth, convex externally and somewhat flattened laterally, with about five faint annulations near its base dorsally.



similar to the central three annuli of previous somites. Somite XXV, the first of the three anal somites, consists of two annuli, equivalent to  $a_2$  and  $a_3$  of previous somites, while the two annuli of somite XXVI are much reduced. Somite XXVII is uniannulate and very small, and the anus opens mid-dorsally on the  $a_1$  annulus of somite XXVI.

**TUBERCULATION.** Text-fig. 29 is derived from the description by Cordero (1937). No details of tuberculation are given for the neck region. Each  $a_2$  annulus of the preclitellar region has four pairs of mammilate tubercles with apical rosettes, one pair para-medianly on the dorsal surface, one pair laterally and two slightly smaller pairs ventrally. Annuli  $a_1$  and  $a_3$  possess five pairs of conical warts with apical rosettes, which are not as conspicuous as those on the  $a_2$  annulus. In the clitellar constriction, annuli  $Xa_3$ ,  $XIa_1$ ,  $XIIa_1$  and  $XIIIa_1$  are generally smooth, while the other annuli are more wrinkled and bear six pairs of small sharply-pointed tubercles each. The  $b_1$  and  $b_6$  annuli of somites XIV to XXIII are smooth, while  $b_2$  and  $b_5$  possess ten mammilate tubercles each, four dorsal, two lateral and four ventral, the centro-ventrals being smaller than their neighbours. The  $a_2$  annulus possesses eight large conical tubercles with rosettes at their summits, two dorsally, two laterally and four ventrally. Annuli  $XIIIa_2$ ,  $b_5$  and  $b_6$  have similar tuberculation to somite XIV. The tuberculations of annuli  $a_1$  to  $a_3$  of somite XXIV are similar to  $b_2$ ,  $a_2$  and  $b_5$  of previous somites and the first and second annuli of somite XXV are similar to  $a_2$  and  $a_3$  of somite XXIV. The  $a_1$  and  $a_2$  annuli of somite XXVI have eight and six tubercles respectively, while the single annulus of somite XXVII has about six tubercles. Small secondary tubercles may be dispersed between the larger tubercles and may even occur in the furrows.

**DISTRIBUTION.**  $34^{\circ} 50' S.$ ,  $52^{\circ} 20' W.$ , 58–65 fathoms; Ilha Rasa, 80 metres depth.

**HOST.** Not recorded.

### **GENUS ET SPECIES INQUIRENDAE\***

#### ***Pontobdella rayneri* Baird, 1869**

*Pontobdella rayneri* Baird, 1869 : 313.

**DESCRIPTION after Baird.** Body cylindrical, attenuated anteriorly. Annuli with tubercles which have sensillae at summit. Preclitellar region twelve tuberculate annuli. Clitellum five tuberculate annuli. Anterior sucker small, circular, with three pairs of papillae on margin and large brown triangular pigment patches. Posterior sucker largest, rayed with brown and with puckered margin. On body, every third row of tubercles is largest. Length 1 inch.

On re-examination of this material it was also found that the posterior sucker was joined to the body by quite a narrow waist; however the material was in too poor a condition to improve on this description. This species is almost certainly a member of the genus *Stibarobdella*.

\* Including *Orientobdella japonica* (Vasiliev), see p. 439.



***Pontobdella leucothela* Schmarda, 1861**

*Pontobdella leucothela* Schmarda, 1861 : 6.

DESCRIPTION *after Schmarda*. Body circular with tubercles on back and sixteen trimeric somites. Neck fifteen annuli. A<sub>2</sub> annuli broadest, with four semi-conical tubercles. Colour yellowish grey, tubercles white. Length 18 mm. This species is apparently a member of the genus *Stibarobdella*.

DISTRIBUTION. Port Jackson, New South Wales.

HOST. Not recorded.

***Pontobdella prionodiscus* Schmarda, 1861**

*Pontobdella prionodiscus* Schmarda, 1861 : 7.

DESCRIPTION *after Schmarda*. Body cylindrical, length 48 mm. and breadth 10 mm., attenuated at each end, tuberculate and a dirty green with a little yellow and brown coloration. Anterior sucker with sixteen rounded tubercles and with eight papillae on the rim. Anterior : posterior sucker ratio 1 : 1.6. Posterior sucker bell-shaped.

Said to have some similarities to the quadriannulate form *Pontobdella spinulosa*, which is now a synonym of *Pontobdella muricata*.

***Pontobdella tatejamensis* Oka, 1910**

*Pontobdella tatejamensis* Oka, 1910 : 171.

*Parapontobdella tatejamensis* : Harant, 1929 : 650.

DESCRIPTION *after Oka*. Body elongated, fusiform, posterior middle half of body expanded like abdomen. Red brown to dark green. Tubercles weakly developed. Suckers small. Lateral vesicles indistinctly recognizable externally. Length of body up to 2 cm., breadth up to 3 mm.

This description gives no sound evidence for placing the leech in the genus *Pontobdella*.

DISTRIBUTION. Hondo ; Awa, Suruga, Sagami.

HOST. Teleost.

***Pontobdella oligothela* Schmarda, 1861**

*Pontobdella oligothela* Schmarda, 1861 : 6.

This species does not belong to the Pontobdellinae since it possesses numerous salient pulsatile vesicles which the latter lack. The rough white patches described on the dorsal surface of somite 10, 11, 14 and 17 on fresh specimens seem to indicate, according to Blanchard (1894) and Harding (1910), that the species is probably identical with *Trachelobdella lubrica* Grube, 1840 : 60, (*Pontobdella littoralis* : Johnston, 1865 and *Pontobdella campanulata* : Johnston, 1865, pp. 42 and 304 were also probably *Trachelobdella lubrica*).

*Pontobdella vittata* de Blainville, 1828

*Pontobdella vittata* de Blainville, 1828 : 557.

Not one of the Pontobdellinae because it possesses no tubercles and probably has biannulate somites.

*OPHIBDELLA* Beneden & Hesse, 1863

*Ophibdella labracis* Beneden & Hesse, 1863 : 25.

The specimen described under this generic name had no tubercles, yet Apathy (1888) believed it was a young Pontobdellinid. However, the hatching young of *Pontobdella muricata* are similar to the adults except in size, so presumably *Ophibdella* should remain a separate genus.

## KEY TO THE SPECIES IN THE SUBFAM. PONTOBDELLINAE

- 1 Abdominal somites triannulate . . . . . Gen. *STIBAROBDELLA* 2
- Abdominal somites quadriannulate . . . . . Gen. *PONTOBDELLA* 9
- Abdominal somites quinqueannulate . . . . . *Pentabdella dispar* (p. 433)
- 2 Anterior sucker with a marginal fringe . . . . . *Stibarobdella loricata* (p. 413)
- Anterior sucker without a marginal fringe . . . . . 3
- 3 Anterior sucker with a pigment patch or patches . . . . . 4
- Anterior sucker without pigment patches . . . . . 7
- 4 Anterior sucker with no papillae . . . . . *Stibarobdella taprobanensis* (p. 421)
- Anterior sucker with papillae . . . . . 5
- 5 Anterior/posterior sucker ratio between 1 : 2 and 1 : 3
- Stibarobdella macrothela* (p. 405)
- Anterior/posterior sucker ratio between 1 : 1 and 1 : 2 . . . . . 6
- 6 Anterior sucker with two distinct pigment patches and anterior/posterior sucker ratio approximately 1 : 1 or latter slightly larger . . . . . *Stibarobdella bimaculata* (p. 415)
- Anterior sucker with single triangular pigment patch and anterior/posterior sucker ratio approximately 1 : 1.5 . . . . . *Stibarobdella tasmanica* (p. 420)
- 7 Anterior sucker with papillae . . . . . 8
- Anterior sucker without papillae . . . . . *Stibarobdella moorei* (p. 422)
- 8 9 tubercles including a mid-ventral tubercle, on the a<sub>2</sub> annulus
- Stibarobdella planodiscus* (p. 418)
- 6 tubercles on a<sub>2</sub> annulus 4 dorsally and 2 ventrally . . . . . *Stibarobdella australiensis* (p. 422)
- 9 Anterior sucker with fringe or welt . . . . . 10
- Anterior sucker without fringe . . . . . 11
- 10 Anterior sucker without pigment patches but with 3 pairs of papillae, anterior/posterior sucker ratio 1 : 1 or former slightly larger . . . . . *Pontobdella muricata* (p. 423)
- Anterior sucker with a pair of pigment patches and 52 marginal papillae and 2 sub-marginal rows of papillae, anterior/posterior sucker ratio approximately 1 : 1.7
- Pontobdella rugosa* (p. 432)
- 11 Anterior sucker with 3 pairs of papillae, anterior/posterior sucker ratio between 1 : 1.5 and 1 : 2 . . . . . *Pontobdella vosmaeri* (p. 427)
- Anterior sucker without papillae, anterior/posterior sucker ratio 1 : 1 or former slightly larger . . . . . *Pontobdella aculeata* (p. 431)

## ACKNOWLEDGEMENTS

In presenting this review I must thank the D.S.I.R. for the award of a Research Studentship, the Trustees of the British Museum (Natural History) for allowing me to study the collection, Mr. R. W. Sims, for much help with the nomenclature and presentation, Professor E. W. Knight-Jones and Dr. K. H. Mann for advice and criticism, and the Director of the Plymouth Laboratory, for access to the collections there and to the library.

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## ADDENDUM

In preparing this review I unfortunately overlooked two species which are important for problems of annulation and affinities of the Pontobdellinae.

The first, *Pontobdella biannulata* Moore (1957. Hirudinea. *Rep. B.A.N.Z. antarct. Res. Exped.* 1929-1931. Ser.B, **6** (6) : 99-105) has two annuli per urosome somite. It may now be placed tentively in *Stibarobdella* if the definition of that genus is widened to include tuberculate leeches with either three or two annuli per urosome somite.

The other species, *Pontobdella japonica* Vasiliev (1939. The Ichthyobdellidae of the Far East. *Works of the Karelian State Pedological Institute*, **1**, Biol. Ser., (1) : 25-68), has fourteen annuli per urosome somite and is now the type of *Orientobdella* Epshtein (1962. A survey of the fish leeches (Hirudinea, Piscicolidae) of the Bering Sea, the Sea of Okhotsk and the Sea of Japan. *Dokl. Akad. Nauk SSSR*, **144** (5) : 1181-1184). Although tuberculate, it has quite large lateral vesicles and it seems doubtful whether it should be included in the Pontobdellinae.